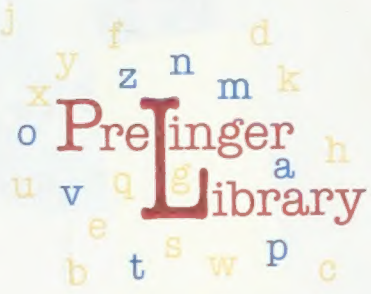
From the collection of the



San Francisco, California
2008

TECHNOLOGY

QA STOR.

SEATTLE PUBLIC LIBRARY
REFERENCE BOOK
NOT TO BE TAKEN FROM THIS ROOM

R

2682445
v.41,no.1/2-
v.42,no.11/12
Jan./Feb.1962-
Nov./Dec.1963

Seattle Public Library
MAR 20 1962
TECHNOLOGY
FILE IN STACKS

CALIFORNIA Highways and Public Works



JANUARY–FEBRUARY
1962

Advisors on Scenic Highways Study Confer



The Advisory Committee on Scenic Highways held its first meeting in the Public Works Building on December 12, 1961. At right, front to back: Robert W. Graver, representing Edwin S. Moore, San Francisco, Executive Vice President, California State Automobile Association; Charles Perry Walker, Manhattan Beach, immediate past president of the League of California Cities; and Robert Grunwald, Hanford, planning consultant. Seated at table, left, front to back: Deputy Director of Public Works Harry D. Freeman, representing the State's previously organized Inter-Departmental Committee on Scenic Highways, of which he is chairman; Lawrence Livingston, Jr., San Francisco, planning consultant; Dee W. McKenzie, Chief of the Highways and Bridge Division, Sacramento County Department of Public Works; and Harry Schmidt, Gustine, immediate past president, County Supervisors Association of California. (Procter Melquist of Menlo Park, editor of Sunset Magazine, was not present). In the background are staff members of the State Division of Highways, Department of Water Resources, Office of State Planning, Department of Parks and Recreation and the U.S. Bureau of Public Roads. The committee was appointed by the Speaker of the Assembly and the President pro Tempore of the State Senate in accordance with Senate Concurrent Resolution 39 of the 1961 Legislature. It is acting in an advisory capacity to a previously appointed interdepartmental committee which is preparing a report for the Legislature, to be submitted in March, 1962.

v. 41, no. 1/2 - v. 42, no. 11/12
Jan./Feb. 1962 - Nov./Dec. 1963

California Highways and Public Works

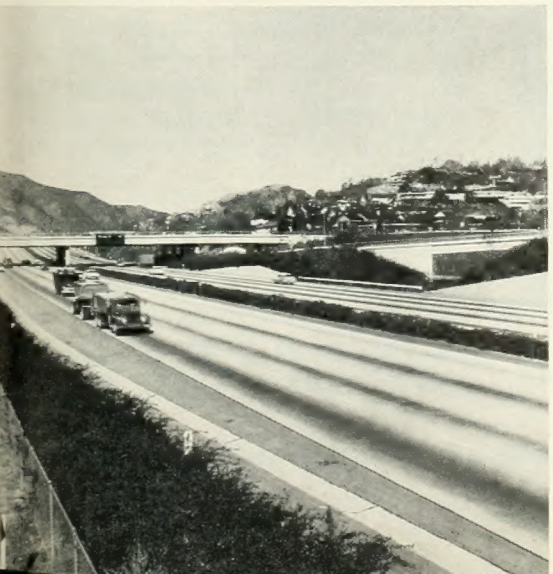
Official Journal of the Division of Highways, Department of Public Works, State of California

Vol. 41 January-February 1962 Nos. 1-2



FRONT COVER—Typical of freeway development in the scenic Redwood Parks area of US 101 in Humboldt County, is this view along the recently opened stretch between Myers Flat and south of Dyerville. The structure across the freeway is the Pesula Road Overcrossing. The old highway, located just west of the freeway and closer to the South Fork of the Eel River, remains in service for leisurely driving through the redwoods. (Article on page 3).

BACK COVER—Looking along a landscaped portion of the San Diego Freeway (Interstate Route 405) in the West Los Angeles area. The Sunset Boulevard overcrossing is in the center. Work is progressing to extend the freeway through the Santa Monica Mountains in the background. (Article on page 45). Both photos are by Bob Dunn.



CONTENTS

	Page
Congressmen Inspect California's Highways	2
Franklin Payne Named to Highway Commission	2
Redwood Freeway By H. W. Benedict, Resident Engineer	3
U.S. 40 By Alan S. Hart, District Engineer	8
San Gorgonio Pass	13
Sacramento River Bridge in Redding Widened	15
South Sacramento Freeway By Donald M. Young, District Construction Engineer, and Edward F. Silva, Jr., Resident Engineer	16
Junipero Serra By Jack O. Grasberger, Senior Highway Engineer	19
Experimental Paint By Herbert A. Rooney, Senior Chemical Testing Engineer, and A. L. Woods, Bridge Paint Inspector	26
Vallejo-Benicia By C. F. Roderick, Resident Engineer	29
Feather Lake By William D. McIntosh, Road Commissioner, Lassen County, and Donald D. Chamberlin, Director of Public Works, Shasta County	33
Bay Bridge	36
Cable Moving By Ralph E. Decker, Senior Highway Engineer, and H. W. Muller, Associate Highway Engineer	44
San Diego Freeway By James E. Martin, Executive Assistant	45
Personnel Changes	60
San Mateo-Hayward Bridge	61
Governor Approves Driver Habit Study	62
Flood Problems—3 By James W. Ross, Associate Highway Engineer, and Wah G. Chan, Assistant Highway Engineer	63
Routes Adopted	66
Maintenance Engineers Meet in Sacramento	68
Construction Costs Show Fourth Quarter Rise	68
New Maintenance Man Classes	69
Vietnam Highways By George E. Gray, Associate Highway Engineer	70
Talking About Highways	72
Index of California Highways and Public Works—1961	76
'Tempus Fugit' Corner	78
New Symbol Signs on State Highways	79
Retirements	
Ralph V. Chase 25	Lee R. Redden 62
William Bock 35	Coral Davis 79
Obituaries	
R. C. 'Cass' Kennedy	79

LESTER S. KORITZ, *Editor*

STEWART MITCHELL, *Associate Editor* JOHN C. ROBINSON, *Associate Editor*

HELEN HALSTED, *Assistant Editor*

WILLIAM R. CHANEY, *Chief Photographer*

Editors are invited to use information contained herein and to request prints of any black and white photographs.

Address communications to: EDITOR,

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

P. O. Box 1499

SACRAMENTO, CALIFORNIA

TECHNOLOGY

2682445

CONGRESSMEN INSPECT CALIFORNIA'S HIGHWAYS



Members of House Committee on Public Works on tour of inspection of civil works and highway projects in California during October of last year make a stop at Jackson, Amador County.

TOP ROW (left to right): A. Garbarini, Publisher, Amador Ledger; John Meyer, District Engineer, State Division of Highways; Howard Anderson and Sheridan Farin, U. S. Bureau of Public Roads; J. C. Womack, California State Highway Engineer; Joseph Brennan, Staff Engineer for Committee; and T. F. Bagshaw, Assistant Director, State Department of Public Works.

SECOND ROW: H. Sherwood, Division of Highways, Marysville; Chas. E. Gordon, President, Jackson Chamber of Commerce; Congressman Walter McVey, Kansas; Congressman Frank Burke, Kentucky; Congressman Harold "Biz" Johnson, California; Congressman Kenneth Gray, Illinois; and R. S. O'Connor, in charge of transportation.

BOTTOM ROW: Alan Hart, District Engineer, State Division of Highways, Marysville; State Senator John Begovich, Jackson; Mrs. Frank Burke; Mrs. Kenneth Gray; Mrs. William Harsha; Mrs. Joseph Brennan, Committee Staff Member; and Congressman William Harsha, Ohio.

Other Congressmen in party, but not shown in photograph: Clifford Davis, Tennessee; John Baldwin, John McFall, Clem Miller, John Shelley, and William Mailliard, all of California.

Franklin Payne Named to Highway Commission

Governor Edmund G. Brown has appointed Franklin S. Payne, veteran newspaper executive and former publisher of the Los Angeles *Examiner*, to the California Highway Commission.

Payne succeeds Robert E. McClure of Santa Monica, who had served on the commission since January, 1954.

The new commission member has been a resident of Los Angeles since 1933, when he was appointed to organize and direct national advertising on the West Coast for the Hearst publications. His overall career with Hearst Consolidation Publications, Inc., covers 41 years. His earlier posts were in Chicago and Detroit.



In 1955 Payne was named publisher of the *Examiner* and served in that capacity until the paper closed early in January 1962. He retired from the Hearst organization on January 15, but is still active in an automobile dealership in Glendale and in other business affairs.

A native of Richland, Iowa, he attended public schools in Chicago. He served in the Army Air Corps in World War I.

Funds Allocated for State Forest Roads

The California Division of Highways, the U.S. Forest Service and the U.S. Bureau of Public Roads have announced the allocation of federal forest highway funds for California for fiscal year 1963 (which begins July 1, 1962).

Funds were allotted for the following construction projects:

$1,200,000 to Forest Highway Route 2, Klamath River Highway, Humboldt County, for grading and surfacing of four miles of State Sign Route 96 between 8 miles and 12 miles north of Weitchpec.

$960,000 to Forest Highway Route 21, Butte County, for grading and surfacing on four miles of State Sign Route 32 between five miles and nine miles northeast of Forest Ranch.

$200,000 to Forest Highway Route 24, Sierra County, for surfacing of six miles of county road between Bassetts and Gold Lake.

$150,000 of additional funds to previously programmed project on Forest Highway Route 35, Calaveras County, for grading and surfacing of 6.8 miles of State Sign Route 4, Ebbetts Pass Highway, between five miles east of Dorrington and Ganns Meadows.

$1,300,000 to Forest Highway Route 48, Fresno County, for grading of 2.5 miles of State Sign Route 168 between Pine Ridge and 2.5 miles west.

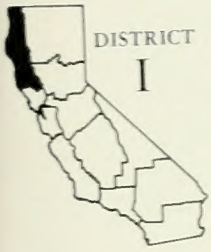
$750,000 to Forest Highway Route 62, Los Angeles County, for grading and surfacing on 1.7 miles of State Sign Route 39 near Crystal Lake.

The number of abstracts of court convictions of persons found guilty of violations of traffic laws received by the Department of Motor Vehicles during November was 238,266.

Redwood Freeway

7½-mile Section Offers Convenience, New Vistas

By H. W. BENEDICT, Resident Engineer



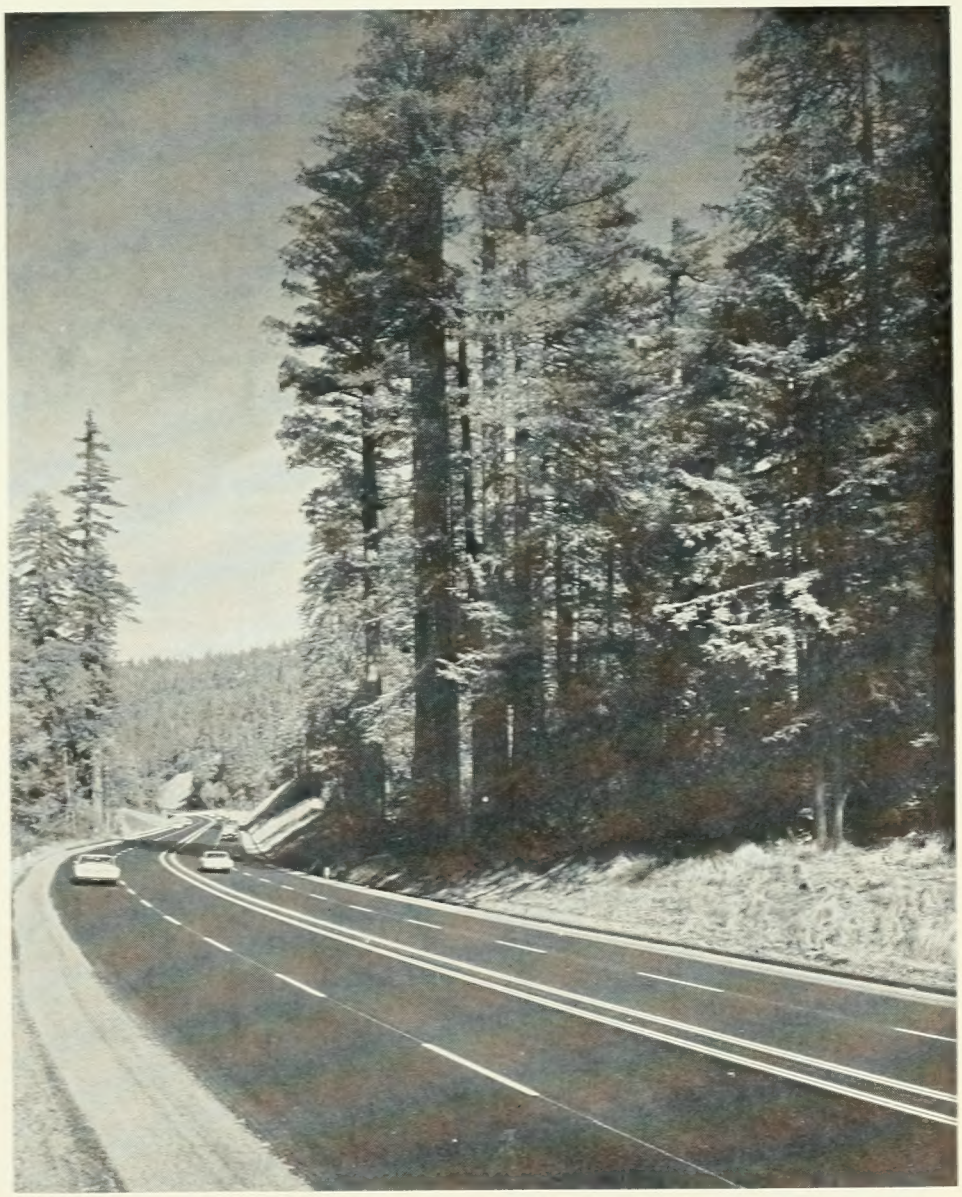
On October 18, 1961, impressive opening ceremonies, attended by many local and State dignitaries, marked the sucessful completion of the second unit of the Redwood Parks Freeway. This unit, extending from Myers Flat on the south to 0.6 mile south of Dyerville, provides an additional 7.5 miles of modern freeway through the beautiful redwood region. Connecting as it does with the first unit of the Redwood Freeway on the north, it provides the highway user with a continuous 12 miles of high-speed four-lane highway, superseding a portion of the originally constructed Redwood Highway.

An over-all picture of the Redwood Parks Freeway was given in an article by Sam Helwer, District Engineer, in the July-August, 1958, issue of *California Highways and Public Works.* As pointed out in this article, the ultimate completion of the Freeway will provide a 44-mile drive of scenic highway through the Redwood country extending northward from the Mendocino-Humboldt county line. This facility will not only provide greater safety, comfort, and convenience for the traveler but also new and exciting vistas of the world-famous redwood groves. Frequent connections to the former two-lane highway, now designated "Avenue of the Giants," will give opportunity for the more leisurely traveler to travel this picturesque route through the groves.

Second Unit Completion

Three contracts were required to bring the construction of the 2nd unit to completion. The first, awarded to Don F. Shuster Co. in August of 1958, provided for the clearing of the right of way. This contract was let separately for several reasons. Primarily, it allowed specialist logging contractors to bid on the complex and difficult "logging" contract.

Some idea of the enormity of this phase of the work is obtained from the quantities involved in the contract; over 160 acres to be cleared and over 6 million board feet of Douglas fir and redwood logs to be removed from the right of way. It also allowed for more balanced financing of the project and insured an earlier completion of the entire facility since it enabled the contractor to work through the winter season of 1958-1959.



A view of recently completed unit No. 2 of the Redwood Parks Freeway (US 101) in Humboldt County between Myers Flat and Dyerville. The traveler now enjoys the comfort and convenience of a modern freeway for 12 continuous miles through the redwood empire as well as spectacular new vistas.



Construction begins on the Eagle Point Viaduct section of the Redwood Parks Freeway south of Myers Flat.

This contract was completed in June, 1959 at the final cost of $251,000.

The second contract was let to John W. J. Petersen and provided for the construction of a 540-foot-long reinforced concrete arch culvert in Mowry Creek. This contract was let in September, 1958 and was completed in July, 1959 at the final cost of $125,690.00.

Mowry Creek is the largest drainage area on the 2nd unit of the freeway and is the site of the largest through fill on the job.

Major Contract Let

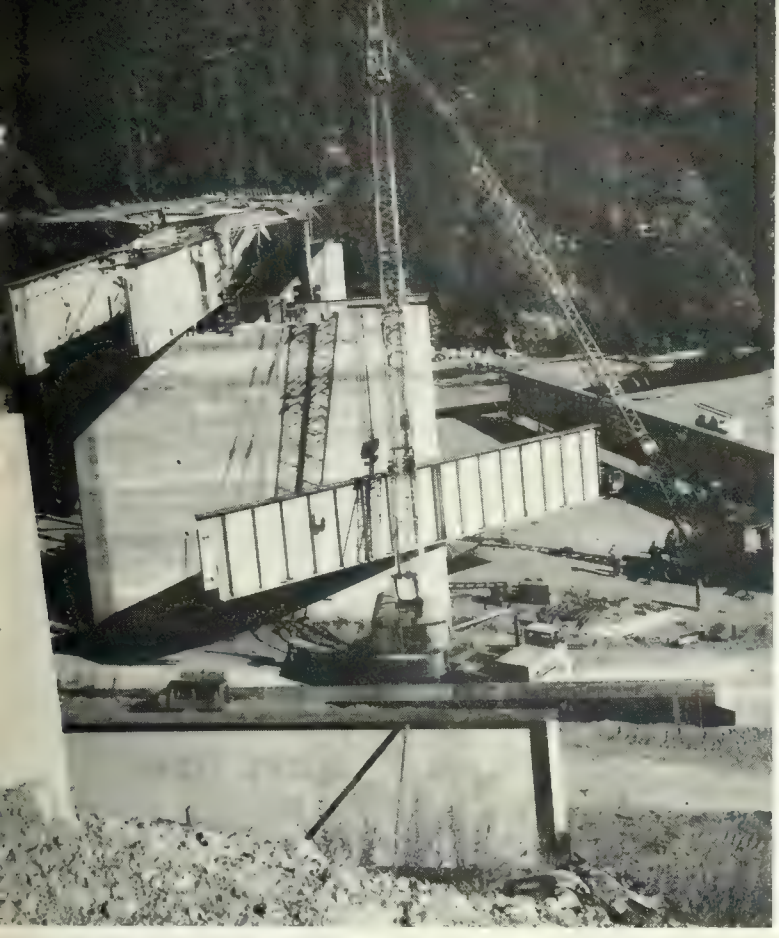
The major contract to grade, pave and construct the structures on the 7.5-mile stretch of freeway was let in June, 1959 to Morrison-Knudsen Company, Inc., Seattle District. This firm successfully completed the work a month ahead of schedule. This contract, completed with the expenditure of over $5,600,000, provided for all the remaining work not covered in the two preceding contracts.

The typical section is the same used on the first unit of the Redwood Freeway and on all mountain sections in District I. Basically, it is the 60-foot all-paved section with modifications for special drainage conditions. Structurally, the constructed section consists of 1.00 foot of imported pervious subbase, topped with 0.66 foot of cement treated base with 0.29 foot of plant mixed surfacing completing the section.

The alignment of the newly completed unit traverses the South Fork of Eel River canyon and is easterly and upslope from the old road. Particular care was taken in the selection of the alignment so as to pass through the many redwood groves in the area with the least disturbance to these last remaining monarchs of a former age. This essential of location, coupled with the extreme rugged nature of the terrain and its generally unstable structure led to many difficult problems in the design and construction of this unit.

Unstable Ground

The unstable nature of the ground traversed by this facility is attested by the quantities involved in stabilization of the embankment areas. Approxi-



A girder is hoisted into position on the new bridge being constructed across the South Fork of the Eel River.



A view of construction now under way on a section of the Eagle Point Viaduct on US 101 south of Myers Flat.



This photo gives some idea of the amount of subsurface water that must be contended with in areas of heavy rainfall such as this section of US 101. Here horizontal drains in a potential slide area carry off water to relieve hydrostatic pressure and lubrication of the earth mass.

mately 545,000 cubic yards of trench and stripping excavation were required to provide for better fill foundations, and over 245,000 tons of filter material was placed for this same purpose. Final quantities show that over 10 miles of perforated metal pipe were placed and over 95,000 linear feet of horizontal drains were installed in the wet sidehill slopes.

To complete the grading on the contract it was necessary to move over 2,800,000 cubic yards of roadway excavation. This material, ranging from soft clays to fractured sandstones, was used to construct the large embankments on the work; in so doing over 30,000,000 station yards of overhaul was performed by the hauling equipment. Approximately 58,000 tons of aggregates were mixed with 2,750 tons of paving asphalt to make the plant mixed surfacing for the project.

Four bridges were constructed, all being separation structures at the various crossroads and at the Weott interchange area. Two of the structures are three-span box girder bridges, one

a tee beam and the last a flat slab structure. The Weott Undercrossing forms an integral part of the Weott interchange, the only complete interchange on the contract. The total cost of the four structures is slightly over $435,000.

Another interchange is planned at the south end of the facility near the town of Myers Flat. All grading and a part of ramp construction was completed in this area under this contract. In addition to the interchanges, private access roads were reconstructed and frontage roads were built.

Construction Restricted

With the exception of private holdings near the towns of Myers Flat and Weott, the new construction traversed lands under control of the Division of Beaches and Parks. Construction through this area was restricted to the cleared area to protect the adjacent forest cover and giant redwoods from damage. Despite the obvious handicaps to normal construction, the contractors were able to maintain these high standards of protection and to preserve the famous groves from damage.

The project schedule carried the work through the winter seasons of 1959-1960 and 1960-1961. Heavy winter storms, particularly in the first winter season, coupled with the generally unstable nature of the terrain, caused heavy slides in practically all the major excavation areas. Over 500,000 cubic yards of slide material was removed from the work and disposed of in various areas.

Extensive reconstruction of failed slopes was necessary and in several areas weakened slopes were reinforced with buttresses of heavy cobble rock. This method of construction, though not new, was unique in that it effectively used the large reject boulders from the contractor's screening plant, material that is ordinarily wasted. In brief, the method of reinforcing the slopes was as follows:

Slopes Undercut

The cut slopes were undercut by at least 10 feet normal to the slope. In all instances, heavy ground water was present in these cuts; consequently, a 3-foot layer of filter material was then placed on the slope, draining to perforated pipe placed in trenches at the normal toe of slope. The slope was then reconstructed with the cobble rock, placed by loaders, clamshell cranes or other convenient methods. The filter blanket is considered essential to the treatment as the cobble rock would probably become contaminated in but a short period of time without this protective blanket.

Rainfall is heavy in this section, averaging between 60 and 70 inches a year. Consequently, particular attention was paid to the design and the installation of drainage facilities. In addition to the concrete arch in Mowry Creek, four other major drainage channels were provided with field assembled metal plate culverts ranging from 5 feet to 6½ feet in diameter. Several miles of conventional corrugated metal pipe culverts were installed to take care of the customary relief drainage. In several areas, extensive ditches, shoulder widening, and



Construction of the freeway involved heavy clearing and the use of heavy logging equipment.

special collecting structures were constructed to minimize the damage from winter runoff.

Even before the completion of this important second link of the Redwood Parks Freeway, work was under way on the third unit. This third unit, extending from Sylvandale on the south to Myers Flat will add another 11 miles of four-lane freeway to the system when completed. For the same reasons of financing, orderly construction, etc., this unit was also divided into several contracts.

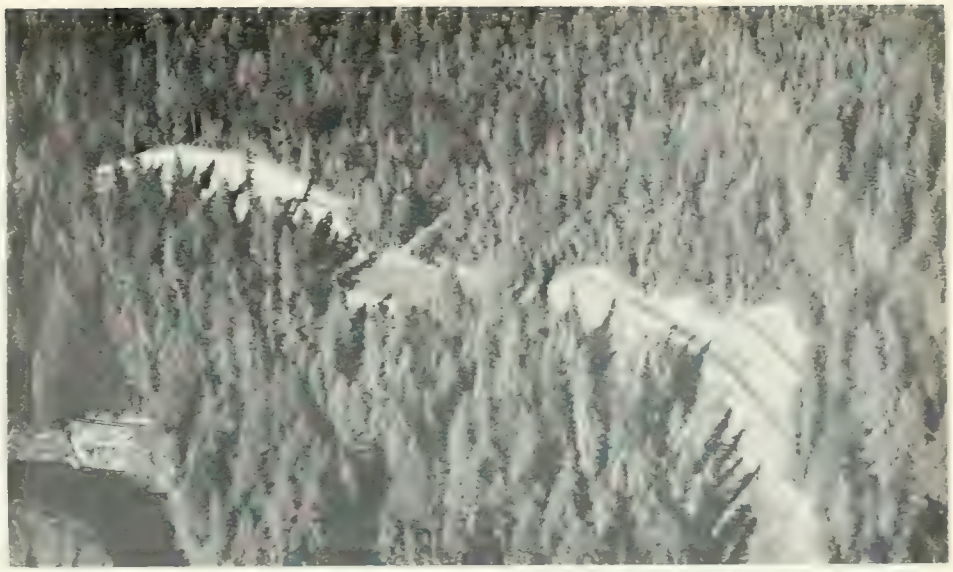
Bridge Contract Awarded

The first, for construction of a bridge across the South Fork of Eel River at Myers Flat, was awarded to Stolte Company in July, 1960. This contract, in the amount of $1,100,000, provides for the construction of a welded steel girder bridge over 825 feet in length and also for construction to subgrade stage of 2,000 feet of roadbed to serve as a southerly approach to the structure. Work on this contract, under the direction of L. C. Allen, Bridge Department Resident Engineer, is well ahead of schedule with completion expected early in the 1962 construction season.

The second contract, for clearing that portion of the third unit covered with heavy timber, was let in August, 1960. Don F. Shuster Co. was again successful in bidding for this work and completed the contract in October, 1960 at the final cost of $70,000.

The third contract was awarded to Ball and Simpson in June of 1961. Work on this $6,000,000 contract is being completed by a joint venture of Ball & Simpson and Slate-Hall Co. This contract, when completed, will extend the freeway southerly to Maple Hills bridge, near Miranda, where a temporary connection will be constructed to connect the new facility to the old road. This temporary connection will utilize an existing county-owned bridge across the South Fork of Eel River at Maple Hills.

Work is progressing rapidly on this 5.6-mile section of the third unit, with completion possible late in 1962. Over half of the 2,200,000 cubic yards roadway excavation has been moved and work is ahead of schedule on the five structures on the job.



The freeway traverses rugged and heavily wooded terrain as can be seen from this aerial photo.

Viaduct Structure

Of particular interest on this contract is the Eagle Point Viaduct structure. This bridge, made necessary when designs studies showed that neither cuts nor fills could be constructed in a steep sidehill location without astronomical costs, is located about a mile south of Myers Flat. Its south abutment is on Eagle Point ridge, the site of the largest cut on the contract where approximately 800,000 cubic yards of material will be removed.

The 1300-foot-long steel girder bridge also has an unusual bent design. Each bent consists of two columns 5 feet square. These columns, due to poor foundation conditions, extend as much as 40 feet into the ground in lieu of the conventional pile or spread footing foundation treatment. In each case, the extended columns were poured against the natural ground in holes dug to neat lines and extending well into bedrock.

The State Highway Commission has included in the 1962-63 budget funds for the final and southernmost contract on the third unit of the freeway. This contract will provide for the construction, including bridges, from Sylvandale to the southerly end of the Ball and Simpson contract at Maple Hills, a distance of about six miles. It is expected that this work will be let to contract early in the 1962 construction season.

In the May-June, 1958, issue of *California Highways and Public Works*, Norman G. Larsen, Project Designer on the first unit of the Redwood Parks Freeway, explained why it was necessary to route the new freeway so as to avoid the level river flats, the location of the stately redwood groves.

As a result of this radical departure from the old highway, that winding, scenic road was left untouched. Consequently, it furnishes an alternate to the new freeway, available to those travelers who wish to travel a more leisurely pace through the beautiful redwood forests. Recognizing the scenic beauty of the superseded portion of the Redwood Highway, the California State Legislature has aptly designated this route as the "Avenue of the Giants."

However, this is not to say that the new freeway is not without beauty. In fact, the more breathtaking vistas of the beautiful redwood forests furnished by this facility have proven to be an extra bonus. Due to the higher elevation of the freeway and its width of clearing, the traveler is able to view new, exciting panoramas of these mighty monarchs. Thus, an early prediction of the original designers has been proven correct; that mountains can be removed, rivers changed in their course, and some redwood giants removed to provide a full freeway and still preserve the awe-inspiring scenic wonder of the area.



Scene during construction, Donner Lake Undercrossing, US 40 and Interstate 80, on new alignment north of Donner Lake.

US 40

Sacramento to Nevada Section Now Has 99 Miles of Freeway and Expressway

By ALAN S. HART, District Engineer



Since our last report on the conversion of US 40 to freeway between Sacramento and the Nevada state line (November - December 1959 *California Highways and Public Works*), two more sections of divided freeway totaling 13 miles have been completed.

Of the total 120 miles, 99 are now four or more lanes on the former emigrant wagon trail which is now a part of Interstate 80. And all 99, except for 14 miles from Auburn east are full freeway. That section requires about a dozen interchanges to provide complete access control and elimination of intersections at grade.

Opened November 1960 was the 7.8-mile project from east of Baxter to west of Emigrant Gap. A. Teichert & Son, Inc. of Sacramento was contractor for the $6,000,000 undertaking.

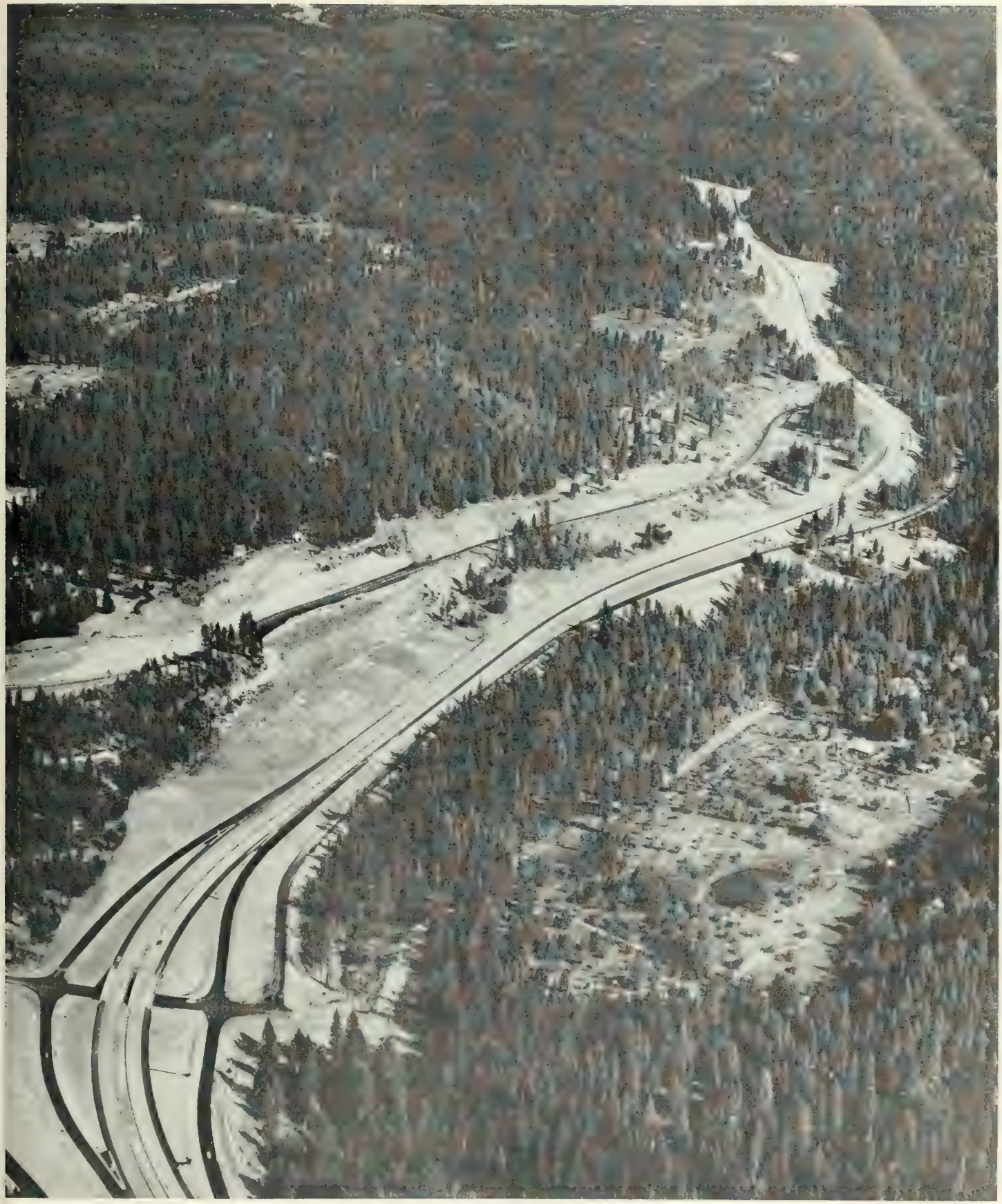
In November 1961 the 5.1-mile stretch from west of Monte Vista to east of Baxter was opened. Its cost was $5,300,000 and Madonna Construction Co. of San Luis Obispo was the contractor.

With the completion of these two sections, the California motorist can now enjoy a total of 72 miles of uninterrupted freeway and expressway of four or more lanes from Sacramento to Emigrant Gap.

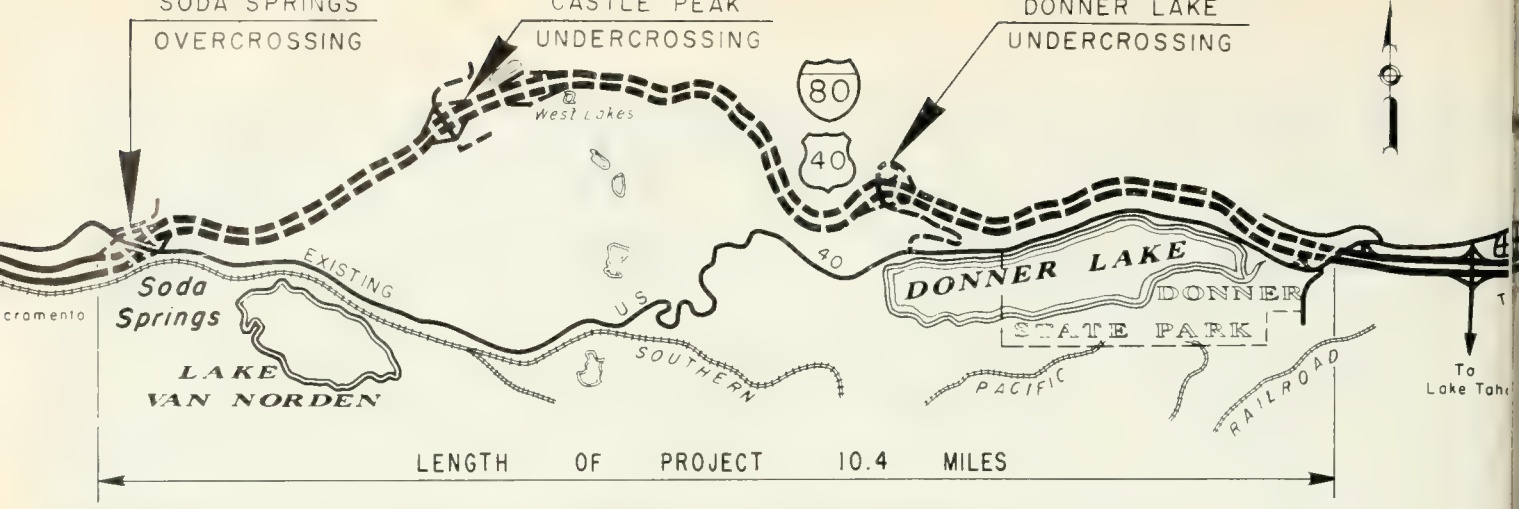
26 Miles Converted

Of the 48 miles from Emigrant Gap to Nevada, 26 have been converted to freeway and construction or clearing is now underway on all the remaining 22 miles.

The 5.4-mile section from Emigrant Gap to the junction of State Sign Route 20 started in July 1961 on the



Recently opened new Interstate Section of US 40/Interstate 80 just above Monte Vista. Southern Pacific Lines run diagonally across photo above highway, in foreground is Towle interchange.



Map of new alignment for Donner Pass. New route crosses summit about two miles north of present summit, in vicinity of West Lakes. Diamond interchange at this point is provided for access to roadside rests at either side of highway when funds are available.



Looking west from outskirts of Truckee along US 40 Donner Lake at left and old Donner Summit upper left. Old roadway closely follows northern shore of lake, new alignment gradually gains altitude up ridge at right, then swings north and west again.

$7,983,500 low bid of Guy F. Atkinson Co. of South San Francisco—the largest contract ever awarded in this district.

Like the completed Hampshire-Rocks-to-Soda-Springs job, this section and the adjacent one will feature two separate roadways mostly on two levels, with the median width varying with the terrain. A full interchange will be built at the SSR 20 junction. Present estimates place completion in the latter part of 1963, depending on weather and availability of materials.

Clearing is in progress on the adjoining 6.3-mile stretch from the SSR 20 junction to Hampshire Rocks. This is a separate $273,000 contract with Hubner & Michner, Inc. of Denver to take advantage of the winter-spring burning season.

For construction, $10,400,000 has been set up in the 1962-63 State Highway Budget, and bids are expected to be advertised some time this spring. At least two and probably three construction seasons will be required to build this section of freeway through the rocky, mountainous country.

Most Challenging Problem

Most challenging as a design problem and most spectacular as an engineering and construction feat is the 10½-mile realignment over the formidable Sierra summit from Soda Springs to the east end of Donner Lake about two miles west of Truckee.

The 21 miles from there to the Nevada line has been completed.

Divided into three contract units for construction purposes, and under-

way for over a year, the summit section will replace the famous, although narrow and circuitous Donner Summit Highway which winds steeply up the easterly face of the solid rock spine of the Sierra ridge.

Work started May 1961 on the grading and structures of the 3.4 miles from the freeway at Soda Springs to the summit under a $2,377,700 contract with Guy F. Atkinson, and work has been going since July 1960 on the seven miles from the summit to the freeway at the east end of the lake. The joint venture firm of J. W. Briggs of Redding, and J. N. Conley and G. D. Dennis & Sons, both of Portland, Oregon, holds this latter $7,423,100 contract. Both jobs are expected to be completed before the end of this year.

Third phase will include the base and surfacing of the entire summit crossing for which an estimated $5,500,000 is required. Present scheduling calls for completion of the entire section in 1965.

Separate Roadways

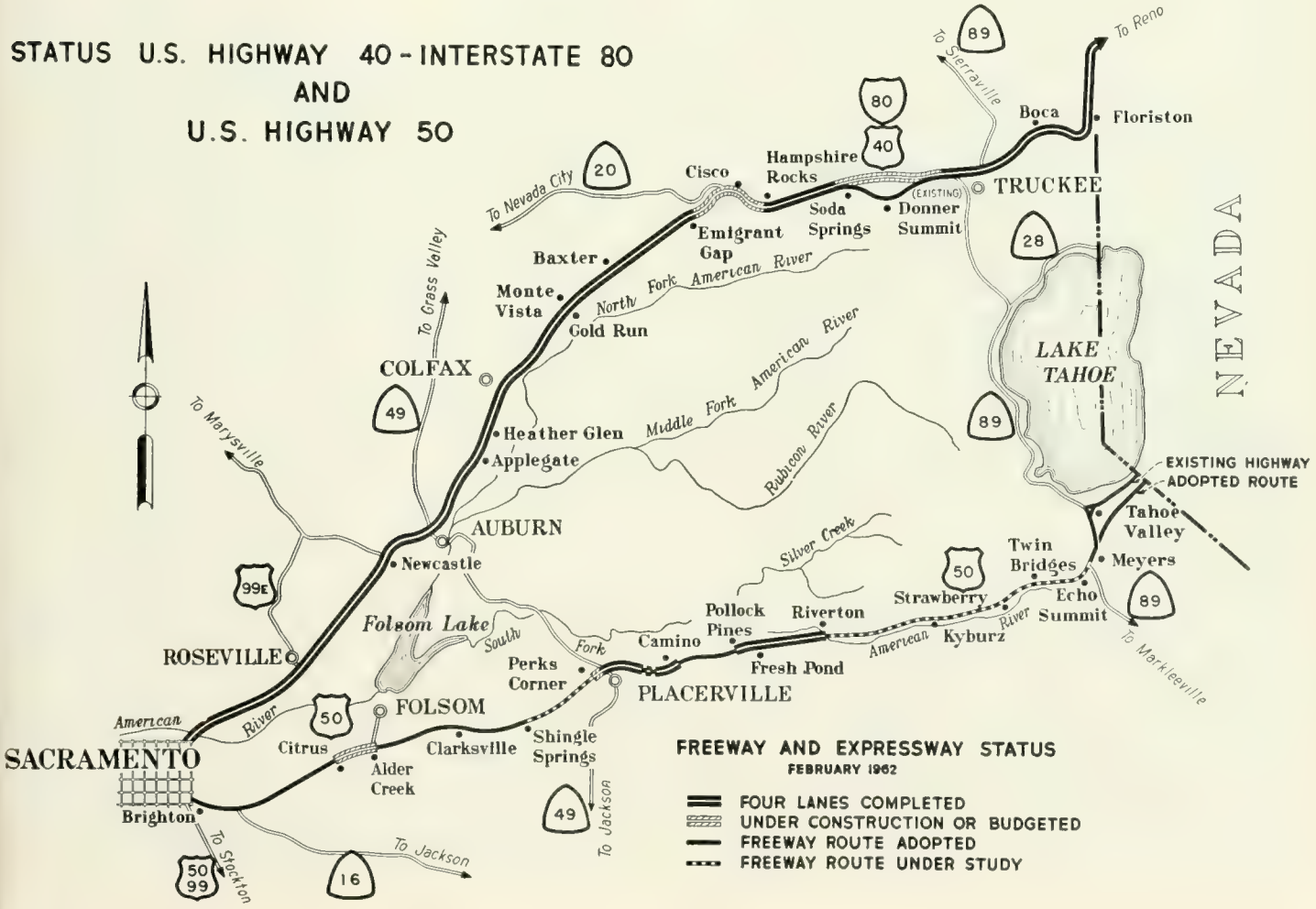
At its farthest point the new route will run about 1½ miles north of the existing highway on sweeping curves with a maximum 5 percent grade uphill and 6 percent down. Each two-lane roadway will be a separate highway with varying vertical and horizontal distances between centerlines.

A third lane will be built for slow-moving uphill vehicles, and a viewpoint vista will offer a dramatic view of Donner Lake and the craggy face of the Sierra.

Although it will peak 100 feet higher than the present road (7,135 vs. 7,239), the new alignment will be more sheltered from the high winds often encountered at the Sierra top,



Aerial view in reverse to one on opposite page shows new alignment swinging north and climbing ridge, while old alignment, just visible middle right continues over summit.



which cause a serious snowdrift problem in winter.

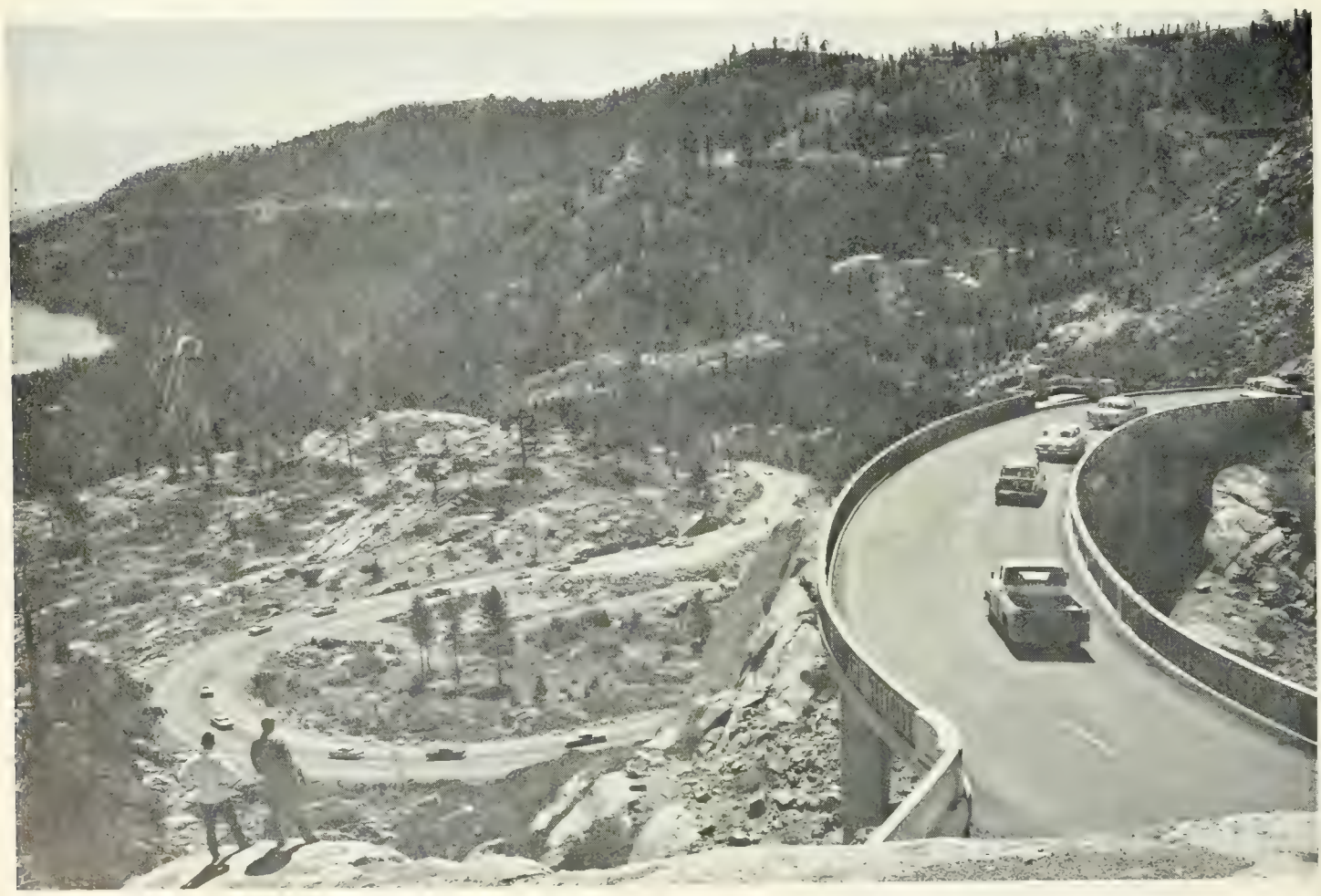
Other recent activity on the transcontinental highway was the million-dollar widening project on the North Sacramento Freeway completed in December. This work expanded the facility to eight lanes between Arden Way and El Camino Avenue, and to six lanes from there to Marconi Avenue, a total of 1.6 miles.

Underway at the present time are two contracts totaling $37,233 for median planting and trees at seven structures on 7½ miles from Roseville to Penryn Road, and for landscaping at the Colfax interchange.

In addition to the conversion of the expressway north of Auburn to freeway, long-range future planning also includes widening the entire route to a minimum of six lanes from Sacramento to the vicinity of Weimar.



Bolted steel plate undercrossing, 7 feet wide, 9 feet high, goes beneath both lanes of freeway near summit, serving riding and hiking trail. Bottom will be paved.



Old Donner Summit road climbs sheer scarp in series of tortuous S-curves, difficult to negotiate and dangerous in winter.

San Gorgonio Pass

New $5,500,000 Freeway Ends Traffic Problem



Completion of a $5.5 million project for freeway construction by Matich Constructors and W. F. Maxwell Co. ends a recurrent traffic problem in San Gorgonio Pass.

Peak flows between the Los Angeles metropolitan area and the Palm Springs-Coachella Valley resort areas have suffered congestion in the pass area, because of the necessary traffic signal controls through Beaumont. This project, which extends the freeway westward from Banning to the junction of U.S. 60 and U.S. 70-99 just west of Beaumont, provides six lanes of pavement for these major transcontinental routes. It is also a portion of Interstate 10.

With completion of this project, Interstate 10 is now built to full freeway standards for the 85 miles from Los Angeles to Banning, with the exception of 11 miles under construction in the Redlands area. The two contracts under way in and near Redlands are expected to reach completion in September 1962.

Extension of the freeway for six miles east of Banning is provided in the current state highway budget, with construction expected to begin this summer.

The new freeway lanes were opened to traffic in August 1961. A short detour has remained in place near the Ramsey Street Interchange in Banning, while modifications were made to convert the former left side off-ramp to a right side off-ramp for eastbound traffic. The conversion was completed in January 1962.

Borrow From One Source

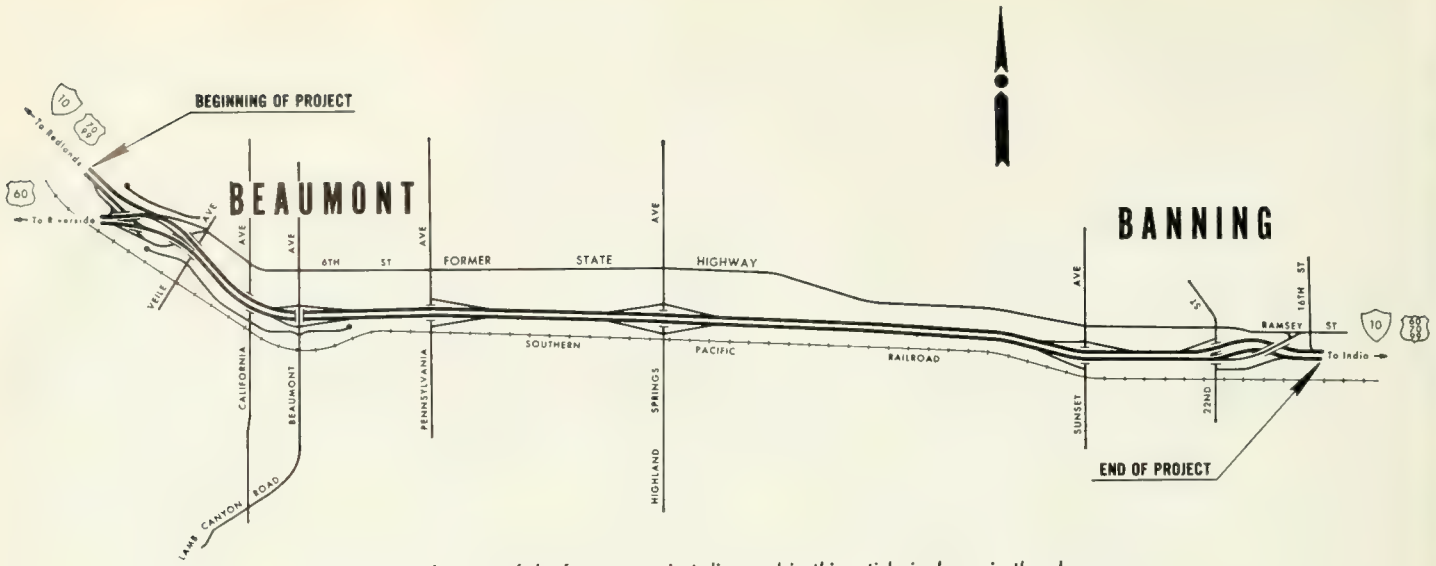
By purchase of property near Sunset Avenue on the south side of the freeway, the contractor was able to obtain about 2,000,000 tons of imported borrow and 198,000 tons of aggregate subbase from one source.



BEFORE—The Sixth and Magnolia Avenue intersection on US 60-70-99 in Beaumont taken in February of last year before the opening of the freeway. The view is eastward.



AFTER—A view of Beaumont following the opening of the freeway, looking west from above Pennsylvania Avenue. Note the lack of congestion on the old highway through the city to the right. Sixth and Magnolia intersection is at white building in upper right.



The location and extent of the freeway project discussed in this article is shown in the above map.

Average daily production of imported borrow from this source was 24,000 tons, utilizing one loader, 10 bottom-dump trucks, six scrapers and two pusher tractors.

The main material source was supplemented by five other sources of imported borrow, aggregating about 800,000 tons, where the contractor was able to grade residential or industrial sites and shorten his haul. Also, by reason of their location in traffic-free areas, the material was hauled to the freeway with a minimum of interference with public traffic.

Unusual features of construction on the project included use of a truck scale with an in-motion weighing device. Photographs show use of this scale in weighing trucks which were moving at about 3½ MPH. A substantial increase in speed of the grading operations was achieved by this device.

Weight Recorded Electronically

The weighing installation is composed of a 70′ x 12′ truck scale of 100 tons gross capacity, with indication in 1/100-ton increments. By means of the electronic attachment, it is possible for DW-20 scrapers or trucks to proceed across the scale deck at reduced speed and, without stopping, register the weight of the load within one graduation, or 1/100 ton. Extensive tests disclose that the scale will hold this accuracy under the most rigorous conditions. As many as 1,090 loads per day have been weighed and recorded.

Traffic control signals mounted at each end of the scale platform are for the guidance of the drivers, alternately showing green or red, thus preventing two trucks from rolling on the deck at the same time. These lights are interlocked with the printer, and operate automatically. The scale provides duplicate paper strip records, the one extruded from the scale housing for the State Division of Highways and the other, wound up inside the printer, for the contractor.

The operator, observing the approaching carrier, punches the number of the rig in the keyboard visible above the paper strip. When the printer is actuated, both the truck number and the weight are recorded.



A new slip-form paver used on the job lays a two-lane width of concrete pavement.

New Slip-form Paver

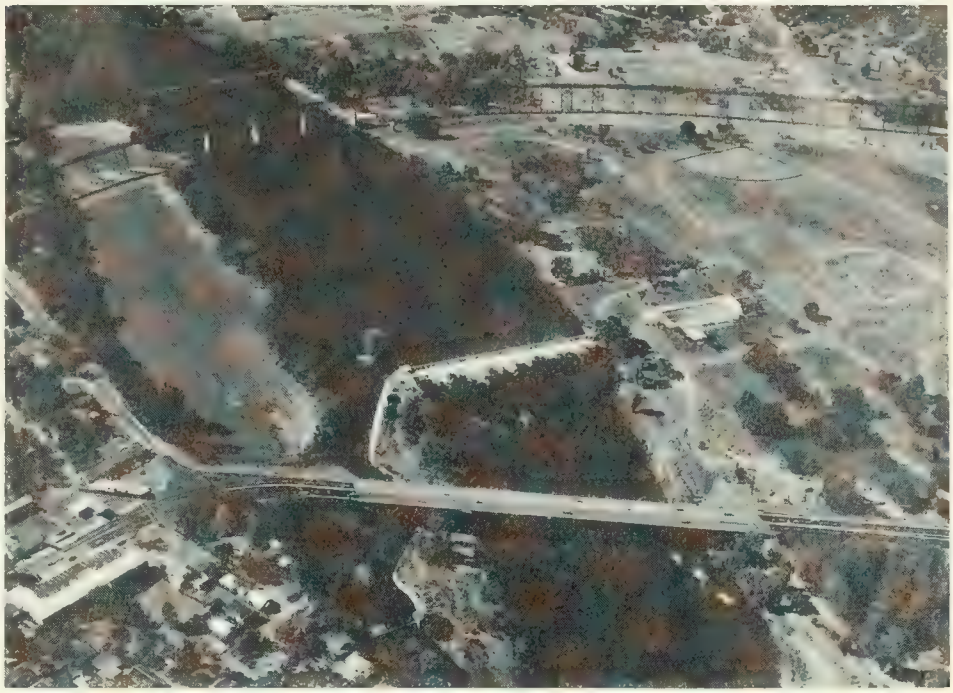
Another unusual feature of the project included the first use of the Lewis slip-form paver for placing a two-lane width of concrete pavement. The accompanying photograph shows the paver in operation. The 6″ diameter pipe float used immediately behind the paver was found by trial during the early days of paving to improve the smoothness of the finished pavement and became, thereafter, a standard procedure. Smoothness specifications permitted 0.01′ deviation from a 12′ straightedge longitudinally and 0.02′ transversally. High spots were ground off by use of a concrete bump cutter with 18″ or 24″ cutting heads, equipped with diamond impregnated cutting blades set at approximately five blades to the inch of head width. Profilographs were used to locate and mark areas which required grinding. Only one run of the grinder was generally required to reduce high spots, although some bumps required a second cut.



A state weighman operates the new in-motion scale. The print-out tape showing the truck number and weight is visible below the weighman's wrist.

Superintendent for the contractor on this project was Glenn MacAfee. State representatives were W. H. Crawford, District Construction Engineer; Ed Walker, Resident Engineer; and W. B. Garrett, Bridge Department.

SACRAMENTO RIVER BRIDGE IN REDDING WIDENED



The structure in the foreground is the Highway US 99 bridge which spans the Sacramento River at Redding. Immediately upstream is the Anderson-Cottonwood Irrigation District diversion dam. The next upstream structure is the 4,353-foot Southern Pacific Railroad trestle. Farthest upstream is the Diestelhorst Bridge which carried Highway US 99 traffic across the river until replaced in 1935.

The Sacramento River Bridge on Highway US 99 at Redding in District II was recently widened to accommodate four lanes which will more adequately handle the traffic volume of 25,000 vehicles per day.

The widening of the Sacramento River Bridge completes an improvement project that was started with the construction of the present one-way system in downtown Redding.

John C. Gist Construction Company of Sacramento was awarded the contract for this bridge project, including approaches, on their bid of $773,035, and began construction work on June 8, 1960. The completed bridge appears as a single structure; however, a new bridge was constructed upstream immediately adjacent to the original 2-lane bridge, utilizing a portion of the original upstream walkway as a part of the median divider.

The completed structure is 783 feet long and the combined over-all width is now 74 feet, 8 inches, with two 28-foot roadway sections and a 5-foot sidewalk on each side. The new bridge section has seven concrete piers, five of which were constructed in the river bed, requiring temporary diversion of the river channel. A total of 2,980 cubic yards of concrete and 665 tons of steel were placed by the contractor to complete the project.

The original 2-lane structure was dedicated in December, 1935, and as an interesting cost comparison, the original project, including approaches, was constructed at a cost of $277,500.

DEPUTY ADMINISTRATOR NAMED

Secretary of Commerce Luther H. Hodges has appointed D. Grant Mickle, traffic engineering expert and former director of the traffic engineering division of the Automotive Safety Foundation, as Deputy Federal Highway Administrator.

The position was established by the Act of Congress which abolished the post of Commissioner of Public Roads.

Mr. Mickle had been with the Automotive Safety Foundation since 1943. During that time, he served as advisor or director for traffic surveys and studies conducted by the Foundation in a number of states and cities throughout the country.

South Sacramento Freeway

By DONALD M. YOUNG, District Construction Engineer, and
EDWARD F. SILVA, JR., Resident Engineer



The first section of freeway to be built in California's capital city was opened to traffic November 22, 1961, when State Director of Public Works Robert B. Bradford cut the ribbon on the 7½-mile South Sacramento Freeway.

The result of many years of planning and design plus three years of construction, the four- and six-lane facility brings the US 50/99 Freeway from suburban southern Sacramento County into the central city area.

It was built under two contracts. Twenty structures, the approach roadways, ramps, and connections to existing streets were completed in September 1959 at a construction cost of $1,973,000 by Lew Jones Construction Co. and Brighton Sand & Gravel Co. of Sacramento, a joint venture firm.

Work started June 1, 1960, by Gordon H. Ball, Inc. of Danville on the highway portion of the project which was completed at a cost of approximately $4,720,000. This contract included grading, paving, three additional structures, drainage pump stations, and installation of signs and safety lighting.

In replacing the former US 50/99 route along congested Stockton Boulevard, the new nonstop alignment provides a minimum radius of curve of 2,000 feet and a maximum grade of 3 percent on the main line, with the exception of the temporary connection to existing city streets at the north end.

Provision for More Lanes

In width, the freeway consists of three miles of four lanes divided from its south end to Florin Road, and 4½ miles of six lanes divided from there to Broadway. Sufficient right-of-way



BEFORE—Old US 50-99 (Stockton Boulevard) at the Fruitridge Road intersection, showing late afternoon traffic before the freeway was opened.



AFTER—The Fruitridge Road West interchange on the new South Sacramento Freeway.

was obtained to accommodate additional lanes when required.

The main line surfacing of portland cement concrete was done by the slipform method which eliminates conventional side forms—the second time this paving technique has been used in District III. On the six-lane portion of the job, it was only the second time that a 36-foot-wide slipform paver had been used on any project in the entire State.

The resulting riding qualities are excellent with an average profilograph reading of 2.9, and an overall range of 0.26 to 4.22 on daily runs.

Some of the major contract items were 1,063,000 cubic yards of roadway excavation, 540,000 tons of imported base materials, and 262,800 square yards of portland cement concrete surfacing. Approximately 112 tons of steel were required for signs and sign bridges.

Travel Time Reduced

Although the lengths of the new freeway and the former street route are almost identical, eight to ten minutes are shaved off travel time when driving the entire distance. Based on preliminary traffic volumes, this results in a total savings of 55 days of time each day the freeway is in use.

The delay on the old route was caused by restricted speed zones, 14 or more signalized intersections (depending on origin and destination), uncontrolled access to the narrow four lanes, and the right-angle left turn from Stockton Boulevard to Broadway near the State Fairgrounds.



The new South Sacramento Freeway looking north toward the downtown area. The Fruitridge Road West interchange is in the foreground.

Even more important is the safety factor. Based on a comparison of Stockton Boulevard's past rate of 5.18 accidents per million vehicle miles with experience factors on comparable full freeways, the new facility is four times safer than the former route. During the first year of operation, it it estimated that approximately 240 accidents will be eliminated from the statistics on this route. Of these, 132, or 55 percent, would have been injuries or fatal fatalities.



SOUTH SACRAMENTO FREEWAY ~ US 50/99



The South Sacramento Freeway during construction showing the connection with Stockton Boulevard (old US 50-99) in the foreground. The view is northward.

Street Traffic Declines

As was expected, when the freeway opened a marked decline in traffic volume occurred on Stockton Boulevard. A few weeks later, preliminary 24-hour counts on a normal weekday were taken at two locations. These were compared with the former counts at the same locations on the previous route, Stockton Boulevard.

One count was taken near the south end of the freeway just north of Mack Road. Readings for a comparable day on Stockton Boulevard before the freeway was activated showed an average daily traffic of 8,000 vehicles northbound and 7,600 southbound. Following the freeway opening, this dropped to 1,700 and 2,300 respectively, with the freeway count 5,500 and 5,300.

Traffic Count Drops

Just north of Fruitridge Road, the old count on Stockton Boulevard was 13,700 northbound and 12,900 southbound. This dropped to 8,500 and 8,400 respectively after the new facility went into use. The initial freeway count here showed 15,750 and 18,300.

This sharp increase of the total traffic on these two routes north of this intersection is accounted for by the fact that the alignment of the new route at this point not only draws traffic from Stockton Boulevard, but also from Franklin and Sacramento Boulevards and other city streets that formerly handled considerable north-south traffic.

Local Motorists Experimenting

Our preliminary studies indicate that local motorists are still in the process of learning how best to exploit the freeway to individual advantage, and it is expected that temporarily the traffic pattern will remain in a state of flux as area residents continue to experiment and learn the advantages of urban freeway service.

Also it appears that many residents from the Fruitridge area are continuing to use their former routes into downtown Sacramento but take the freeway for their trip home.

Wells Being Drilled

Under an $18,620 contract with Arnold Bowline of Bakersfield, eight wells are presently being drilled and developed at various locations along the freeway to provide irrigation for future landscaping.

Included in the 1962-63 construction budget is $442,000 for extensive landscaping of the northern three miles from Sacramento Boulevard to U Street. Another planting project is planned for the remainder of the new freeway in the future.

Freeway Will Be Extended

From the temporary connection at the north end of the project, additional freeway will ultimately extend north through the city between 29th and 30th Streets to join the Elvas Freeway near the north city limit. Right-of-way acquisition on this section is well advanced. This section will become part of Interstate Highway 80.

Other future planning in the vicinity includes a proposed east-west freeway, also a part of Interstate 80, which would run between W and X streets and will connect with the north-south route at a major interchange.

The total number of driving tests given by the Department of Motor Vehicles during November was 92,-140. Of these 17,604 resulted in driving test failure.

Junipero Serra

Advance Planning Pays Off On Interstate Route 280

By JACK O. GRASBERGER, Senior Highway Engineer



In the spring of 1784 Father Junipero Serra laboriously made his way along El Camino Real to pay a last visit to the Mission San Francisco de Asis. No doubt, as he traveled northward along the bay front, he would often gaze westerly toward the beautiful hills which separate San Francisco Bay from the Pacific Ocean. Today, these hills serve as the location for a future interstate highway extending from San Francisco to San Jose and appropriately known as the Junipero Serra Freeway.

The story of this freeway has its beginning during the years following World War I when the mass production of automobiles and development of the San Francisco Peninsula combined to create a major transportation need.

Joint Highway District 10

As early as 1928, the need for an additional arterial highway extending from San Francisco southerly to the San Jose area was recognized. Joint Highway District 10, comprising San Francisco and San Mateo Counties, was created and by 1939, a location for a four-lane highway, to be known as Junipero Serra Boulevard, was planned as far south as the Santa Clara county line. This routing followed what was then the westerly edge of the developed area, generally along the foothills on the east slope of the coastal ridge. The projected right-of-way was delineated with iron pipes, bringing forth a flood of protests by affected towns from Burlingame to Menlo Park.

A seven-mile portion extending as far south as Crystal Springs Road in San Bruno was constructed by 1952, with rights-of-way largely acquired through Millbrae.



BEFORE—Looking SW along El Monte Avenue in the town of Los Altos Hills (see photo below).



AFTER—Retouched photo indicating artist's conception of proposed interchange with an improved (four-lane) El Monte Avenue. The initial location for the Junipero Serra Freeway was modified to avoid conflict with plans for the Foothill Junior College.

During the ensuing years, financial problems and diverse opinions as to the routing and recognition that the scope of the needed highway improvement was of more than only local concern led to the conclusion that further development of this route should be a state responsibility. In 1956, the Legislature included the constructed portion in the State Highway System as Route 237.

The Division of Highways, in cooperation with the U. S. Bureau of Public Roads, was concurrently proceeding with the study of possible routes for the National System of Interstate and Defense Highways authorized by Congress. This route was included as an Interstate route in 1955, and by 1957, the Legislature had included new Route 239 in the State Highway System, extending from San Francisco to U.S. Route 101 near San Jose. It is now also designated as Interstate Route 280.

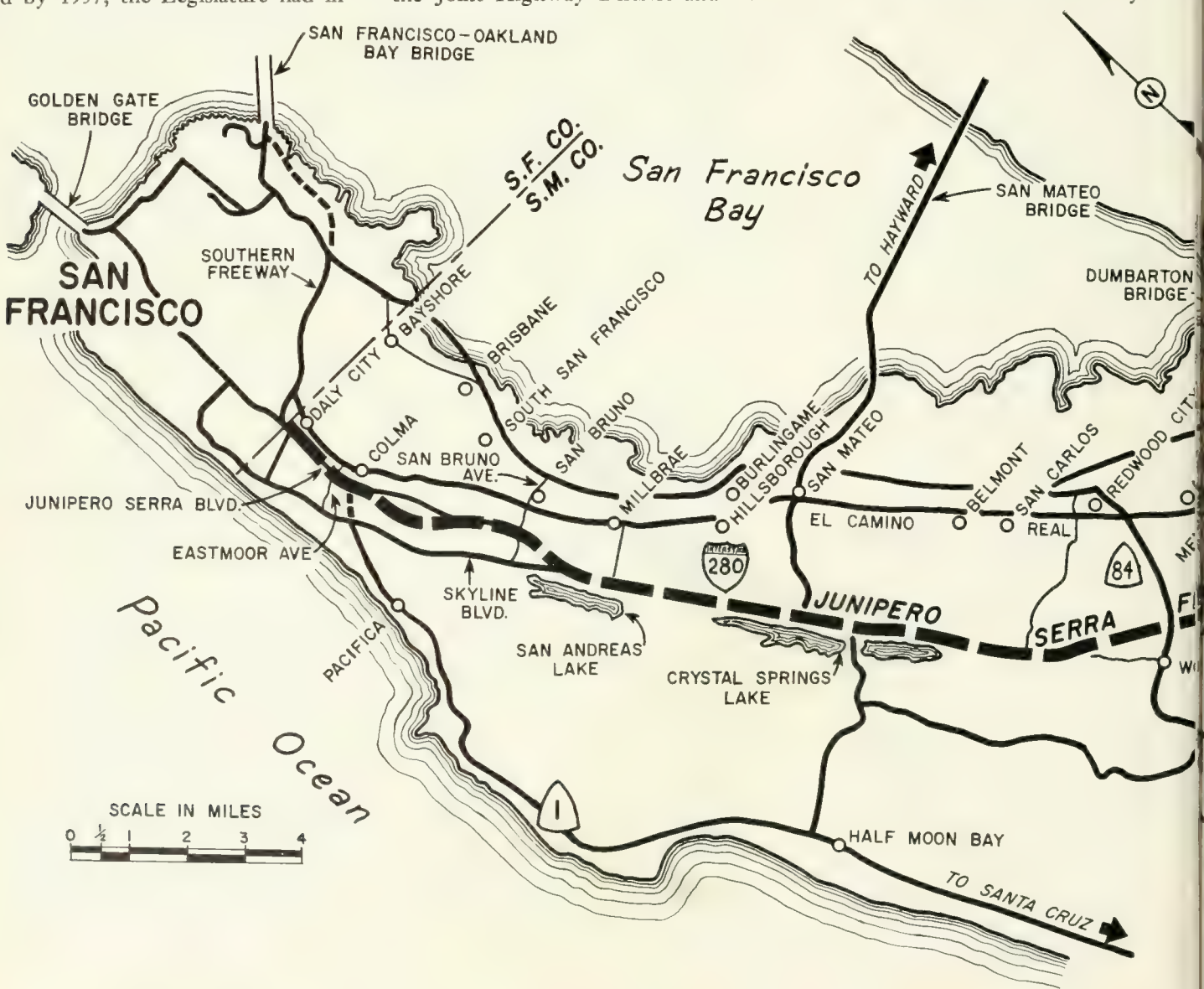
50 Miles of Paper Highway

Preliminary planning studies were well along by early 1957. Aerial mosaics and topographic maps at scale 1″ = 300′ had been ordered covering all possible route locations within both San Mateo and Santa Clara Counties. Contour interval was 1″ = 10′.

Two basic locations were developed and referred to as alternates "A" and "B." The "A" alternate followed generally the original location projected for the Junipero Serra Boulevard by the Joint Highway District and was the most easterly and closest to built-up areas in both San Mateo and Santa Clara Counties. Alternate "B," the more westerly location, followed Skyline Boulevard along the coastal ridge in northern San Mateo County and thence generally along the foothills to the west of alternate "A." Later, additional alternates were developed, mostly to the west and further away from the developed area. These latter studies were made at the request of the cities and counties and certain civic groups.

First Public Meetings

From April through July of 1957, more than 40 public meetings were held with local governmental officials, civic bodies and local community or-



ganizations for the purpose of explaining in detail the studies that had been made. After new studies of additional routings had been suggested and made, district public hearings were scheduled in San Jose and Sunnyvale to discuss alternative locations in Santa Clara County.

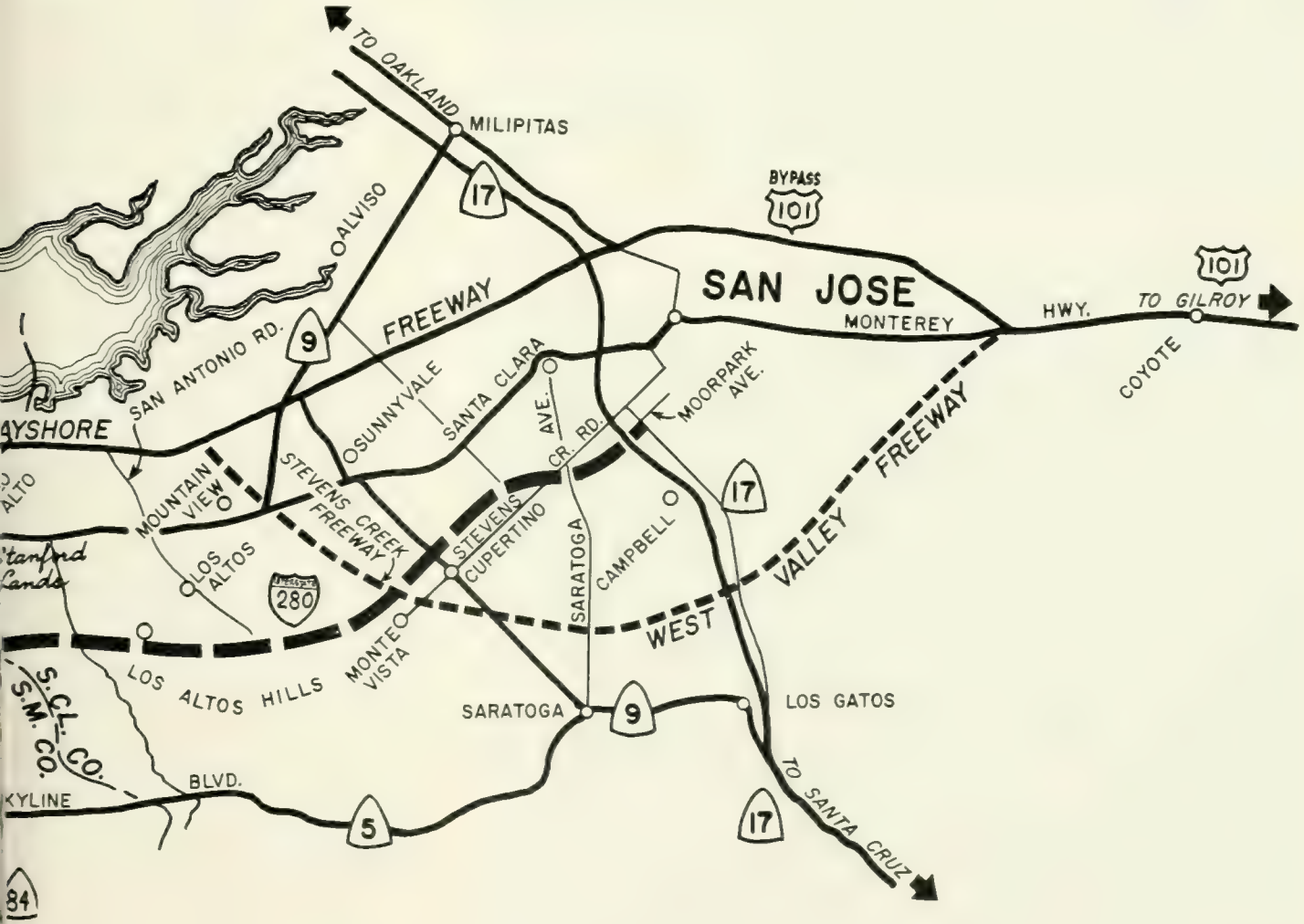
A method of analysis was developed whereby alternative locations were considered as part of a freeway system, including all of the existing or planned major routes in the area. Every effort was made to simplify the analysis for public presentation, but the description of an alternate routing such as the "B-B4-U1-A—" was not unusual for a location within just the northern part of Santa Clara County.

What is now known as the West Valley Freeway bypassing San Jose to the south, and a two-mile length of the Junipero Serra Freeway along Moorpark Avenue in San Jose were adopted by the California Highway Commission on November 25, 1957. At the same time, a southerly extension of the Stevens Creek Freeway was adopted, establishing a continuous location for the West Valley Freeway. A route bypassing San Jose to the south, as intended by the Legislature, had been established. However, only a small portion of the Junipero Serra Freeway routing had been adopted. More than 35 miles of location was still to be determined to the north and through San Mateo County.

Don't Muddy the Waters

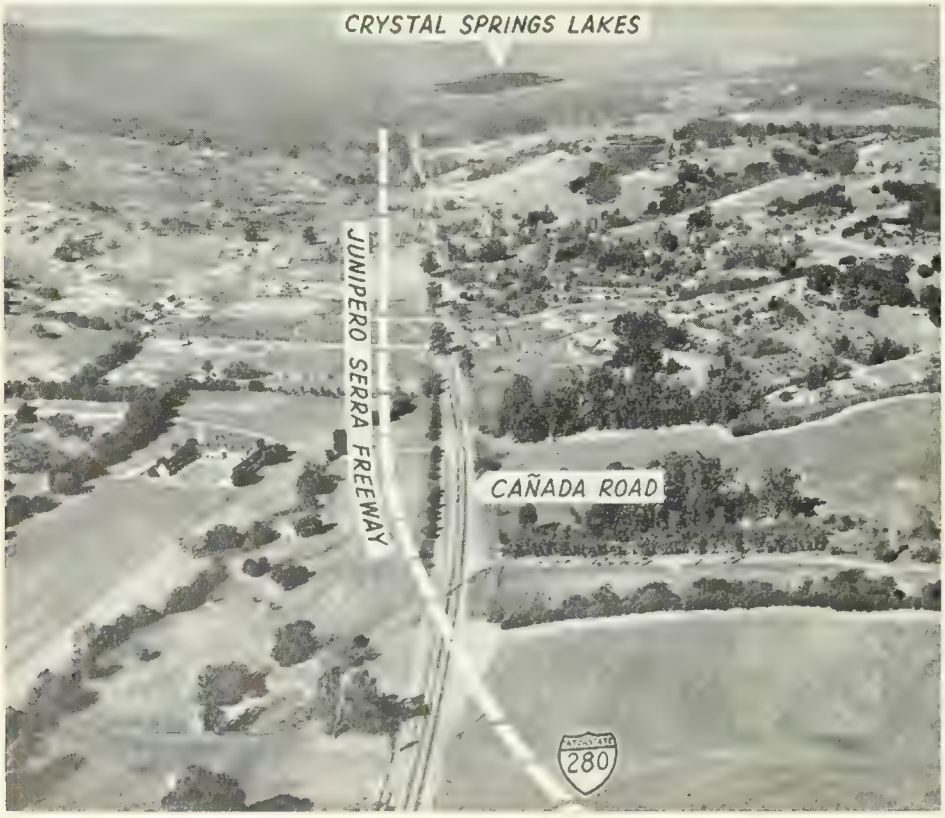
By the summer and fall of 1957, District public hearings had been held in San Mateo and Santa Clara Counties. These hearings covered the portion of the route extending from San Bruno to the previously adopted section in Santa Clara County. The local governmental agencies were virtually unanimous in their opposition to Route A, located through the highly developed portions of the peninsula and to the east of Skyline Boulevard. In San Mateo County, Route B, located along Skyline Boulevard, appeared to be most feasible.

A multitude of considerations are necessary in the study and selection of a major route. To properly locate a freeway route, consideration must be





Looking northwest along Purissima Avenue in the town of Los Altos Hills. Hoover Tower on the Stanford University Campus can be seen in the background. Wherever feasible, separate alignment and grades for each roadway with wide median areas for planting will be used.



A view looking northwest along Canada Road in the town of Woodside. Watershed lands of the City and County of San Francisco in the background. This beautiful valley is only 4 miles west of El Camino Real.

given to both the motorists who will use it and the communities through which it passes. All possible alternate routes are investigated so that the final result will afford the best traffic service at the least possible cost, consistent with minimum disruption to community values.

More than 14 miles of the Skyline route traversed lands of the watershed area owned by the City and County of San Francisco. Domestic water supply for San Francisco and most of the northern peninsula is impounded in San Andreas and Crystal Springs lakes, located just west of Skyline Boulevard.

Originally, water supply was limited to runoff from the watershed lands. As water needs increased, additional water had to be brought in from outside sources as far as the High Sierra, and the reserviors now serve as terminal storage for the Hetch-Hetchy System, provide for seasonal fluctuations in consumption and protect against water shortages resulting from limited local runoff. This water supply is of very high quality and does not require filtration treatment.

Meetings were held with representatives of the Water Department who were concerned about the danger of pollution or increased turbidity of the water by reason of highway construction activity. At the same time, a citizens committee, representing property owners along Skyline Boulevard, proposed that the highway be located farther to the west and closer to the lake. Such a location would preserve existing homes, but would place the freeway westerly and well below the Skyline ridge, causing severe problems in drainage control, particularly during construction when it was feared that storm runoff would carry mud and debris from the construction down into the reservoir.

Studies were made to determine if storm runoff could be controlled during construction so as not to increase turbidity in the lakes. Cost estimates for an extensive drainage control system were included as part of each alternate, including the one suggested by the citizens committee which encroached deep within the watershed area.

Commission Hearings

In the spring of 1958, public hearings were held by the California Highway Commission in both Santa Clara and San Mateo Counties. The State Highway Engineer recommended a route generally following the Skyline location in San Mateo County and a location through the lands of the Leland Stanford University, acceptable to their Board of Trustees. The location through Los Altos Hills in Santa Clara County was recommended as being in the best public interest.

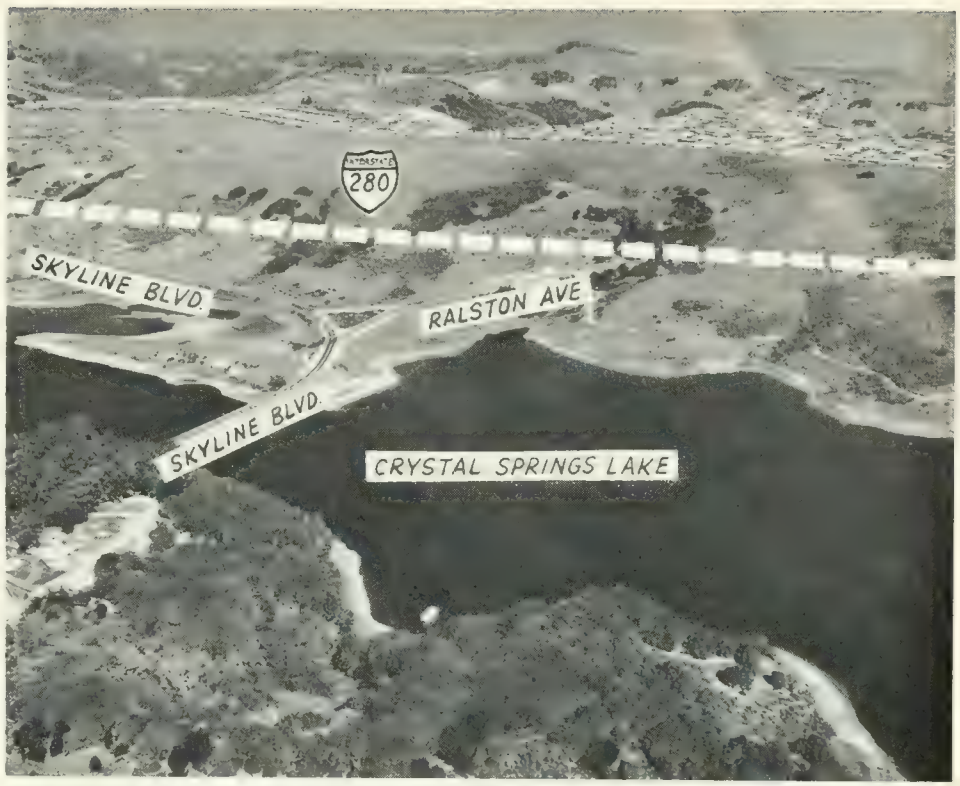
The recommended route represented a modified location over that originally conceived, in terms of better fitting local planning and requiring fewer homes. Actually, an estimated 84 improved properties would be required by this 35 miles of freeway, an amazingly low figure in this rapidly growing suburban area.

After careful consideration of testimony by local governmental agencies, citizens groups and individuals, and subsequent reports by several agencies and groups, the Commission adopted the route recommended by the State Highway Engineer. This location truly represented exhaustive negotiations and considerations with reasonable compromise between the Division of Highways and local representatives and resulted in an unusual degree of concurrence by all concerned.

The adoption of the route from San Bruno to San Jose by the California Highway Commission on July 23, 1958, set the stage for the commencement of design study. Location studies were still in progress for 8 miles of the route north of San Bruno to the San Mateo County Line. A route for this portion generally following the existing Junipero Serra Boulevard was adopted in 1960, thus establishing the general route in its entirety. The Junipero Serra Freeway had been located and approved as a basic 8-lane interstate freeway with minimum median width of 22 feet.

Freeway Agreements

Preliminary to actual design, it is necessary to negotiate agreements with each city and county involved in location of the freeway. The number and location of interchanges which



An easterly view showing the Crystal Springs Lake in the foreground. Residential development has reached the east boundary of the watershed lands in this area.



Looking east along San Mateo Creek Canyon. The Crystal Springs Lake and Dam will be visible from future bridge over the canyon, providing a breathtaking view for future motorists.



A westerly view of the Crystal Springs Lake and Dam showing the coastal hills in the background. The future bridge will be about 1,700 feet long across the canyon and about 100 feet above the dam.

relate directly to the traffic service afforded each community, establishing which local streets would be carried over or under the freeway, and which would be cut off by the construction of the freeway, are all part of what is known as a Freeway Agreement negotiated between the State and local jurisdiction. Since 1958, 18 freeway agreements have been executed with the cities and counties for the Junipero Serra Freeway.

Once the general details of the freeway interchanges and road separations have been worked out with local authorities, the Division of Highways can proceed with detailed design. Numerous special design problems have been encountered in the design of this freeway, including preservation of the pure water impounded in the San Andreas and Crystal Springs reservoir.

Design Problems

One major problem in the design of the freeway in northern San Mateo County has been the increased subdivision activity bordering the adopted location. Every effort is made to cooperate with local agencies and keep to a minimum the number of improved properties required to build the freeway. The early adoption of the route, and the relatively few improvements which need be disturbed, emphasize the advantage of advance planning.

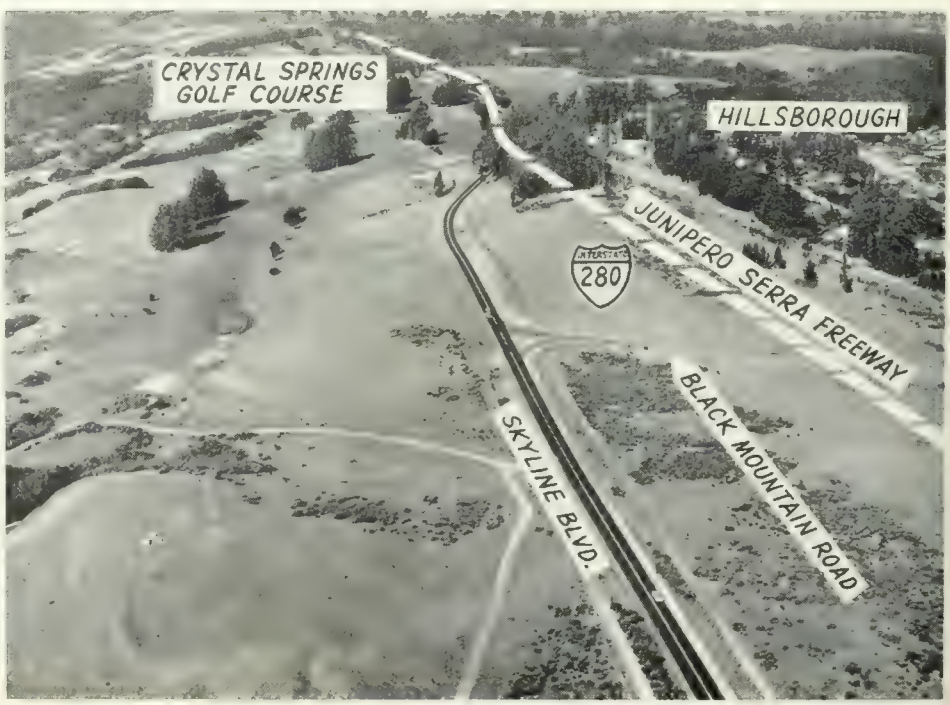
A depressed 12-lane freeway is planned in Daly City where two major traffic corridors coincide. The north-south corridor includes the Junipero Serra Freeway in San Mateo County and Junipero Serra Boulevard in San Francisco. The east-west corridor includes the Sign Route 1 Freeway (from the coast) and the Southern Freeway in San Francisco. These two traffic corridors coincide for over a mile and will carry an estimated 150,000 vehicles each day by 1975. This is in excess of volumes presently carried by any freeway in the Bay area and requires special design study.

The possibilities of using a dual-dual system of lane arrangement, or what amounts to a freeway within a freeway, were studied and rejected because of excessive right-of-way requirements and inherent inflexibility in the event of unforeseen traffic distribution.

In southern San Mateo County, it will be necessary to bridge the proposed two-mile long, underground, linear accelerator planned for Stanford University. The proposed Ladera Dam flood control and water retention project will further complicate design of the freeway through Stanford lands, and consideration of its possible future construction resulted in some modification of both route and design.

A Beautiful Highway

The Division of Highways has been in contact with many public agencies and private organizations interested in



Looking north along Skyline Blvd. on location through the watershed lands of the City and County of San Francisco. Modifications to the Crystal Springs Golf Course are planned.

esthetic treatment for this freeway. The State Division of Beaches and Parks, the San Mateo County Park and Recreation Commission, the San Mateo County Horsemen's Association and the Tri-County Committee for Freeway Beautification, composed of representatives from San Mateo, Santa Clara and San Francisco Counties, have exchanged ideas and information designed to preserve the natural beauty of the areas through which the freeway will pass.

In areas of rugged terrain and wherever feasible, separate alignment and grades for each roadway will be used. This "split level" design will be used extensively in both San Mateo and Santa Clara Counties in order to better fit the country and minimize cuts and fills. In some instances, median planting areas may exceed 100 feet in width.

A new high-level bridge will carry the eight-lane freeway over San Mateo Creek Canyon. The bridge, not yet designed, will be about 1,700 feet long and over 275 feet above the canyon floor. The bridge site will be just east of Crystal Springs Lake Dam and future motorists may anticipate a breathtaking view of the lake.



A westerly view of San Andreas Lake and Skyline Blvd. Development in foreground within the City of Millbrae is typical of other areas adjacent to the freeway location in northern San Mateo County. In spite of heavy development, only an estimated 84 improved properties need be moved in the 35-mile stretch from San Bruno to San Jose—thanks to advance planning.

Construction Units

Present plans call for 16 separate construction projects extending a total distance of almost 50 miles from San Francisco to San Jose. The first of these, scheduled for construction in 1962, starts in San Jose at the San Jose-Los Gatos Freeway and extends northerly for approximately 4.5 miles to Doyle Road. $4,750,000 has been included in the 1962-63 State Highway Budget for construction of this first unit. It is hoped that the entire freeway will be constructed, under construction, or financed within five years. Since this route is part of the Interstate Freeway System, federal financing will amount to about 92 percent.

The total cost is estimated at $145,000,000—about $110,000,000 for construction and $35,000,000 for rights-of-way. Of the latter amount, approximately $7,000,000 has already been expended and another $11,000,000 has been made available in state highway budgets through June 30, 1963.

When completed, this scenic, interstate freeway will provide much needed relief for peninsula traffic, doubling the existing freeway capacity south of San Francisco and will relieve heavy congestion now experienced in Bayshore Freeway. It will doubtless serve to accelerate development of the hills west of peninsula cities and in years to come be as familiar to peninsula travelers as the El Camino Real of old or the Bayshore Freeway today.

L.A. Design Chief Ralph V. Chase Retires

Ralph V. Chase, Assistant District Engineer for District VII in Los Angeles, retired early this year after almost 28 years with the Division of Highways. Since 1956 he had been in charge of design for state highways in Ventura County and the north portion of Los Angeles County.


RALPH V. CHASE

In his career with the division, Chase spent five years in construction and close to 23 years in design. He was Resident Engineer on portions of the Angeles Crest Highway and the Ventura Freeway. As a senior highway engineer he supervised design of the Harbor Freeway and portions of the San Diego and Golden State Freeways.

A native of Deer River, Minnesota, he attended grade school in Idaho, Missouri, and Minnesota, and high school in Minneapolis, Minnesota. He studied engineering at the University of Minnesota and the University of Southern California.

He and his wife, Clare, have one son, Donald.

Experimental Paint

Corrosion Resistance Tested On Leffingwell Creek Bridge

By HERBERT A. ROONEY, Senior Chemical Testing Engineer, and
A. L. WOODS, Bridge Paint Inspector



In accordance with the continuing research program of the Technical Section of the Materials and Research Department concerning the development and application of improved corrosion resistant paints this report describes the experimental paint systems applied to the Leffingwell Creek Bridge in October 1958, and the results observed as of May 1961, after an exposure period of 2½ years.

The Leffingwell Creek Bridge is situated just north of the town of Cambria on Road V-SLO-56-B (State Sign Route 1) in San Luis Obispo County and is close to the shoreline of the ocean as shown in Figure 2. It is a low level structure containing eight steel stringer spans with a concrete deck supported on concrete piers and abutments. The 24-foot wide concrete deck shields the steel girders to a limited extent from rain thereby allowing salt to accumulate in heavier deposits than would occur if the steel were more exposed as in a superstructure. This bridge and several others similarly situated with respect to the ocean present an ideal location where protective coatings may be tested in a very corrosive environment.

Poor Correlation

Although accelerated laboratory corrosion tests to determine the protective quality of paints are often made in salt spray cabinets, there is frequently poor correlation between laboratory tests of this type and actual corrosion observed when the paints are applied in a natural corrosive environment. This is true for many reasons. Panels exposed in a salt spray cabinet are normally painted under ideal atmospheric conditions in the

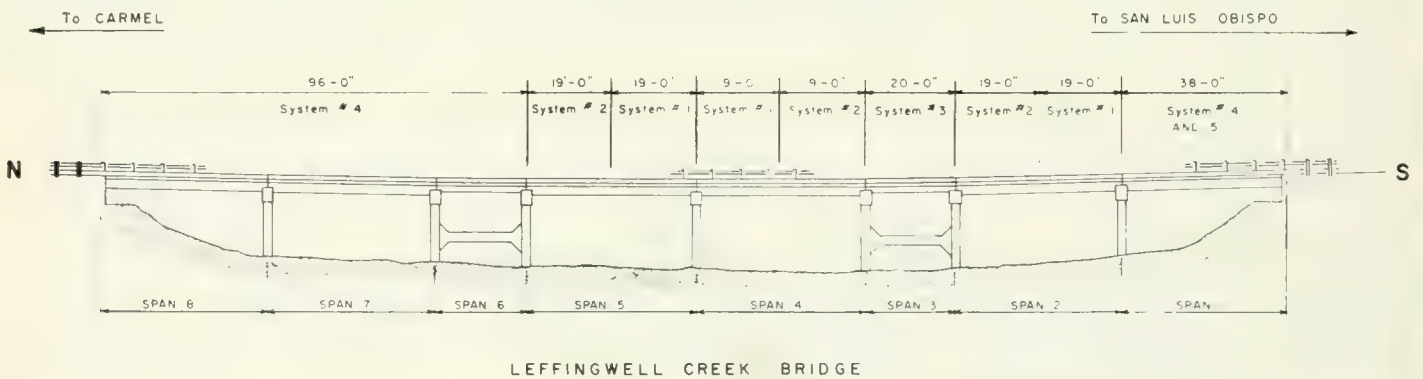


FIGURE 1—A diagram of the Leffingwell Creek Bridge on State Sign Route 1 in San Luis Obispo County showing the location on the structure of the various systems of painting discussed in this article.



FIGURE 2—A photograph of the actual bridge shown in the diagram above. Note the beach and surf line in the lower right corner.



FIGURE 3—Under view of the south portion of Span 2 on which Painting System No. 1 was used.

laboratory before they are placed in the cabinet. Paint is applied to structures like the Leffingwell Creek Bridge and bridges in similar areas along the coast where the humidity is frequently in the range of 70-80% and above and the air temperature seldom greater than 60°F. The solvents in the paint cause moisture from the humid atmosphere to be carried into the paint film during application due to the cooling effect produced by the vaporization of the solvents.

Even if paint could be applied under ideal conditions to structures in this coastal zone, discrepancies between salt spray cabinet tests and field testing would still be evident since weather cycles cannot be duplicated in a salt spray apparatus. Both the composition of the salt and the nature of the exposure do not reproduce conditions occurring in the natural environment. However, salt spray cabinet and weatherometer tests do have some value in their ability to separate the very poor from the better types of corrosion resistant paints.

Description of Coatings

Figure 1 is a drawing of the Leffingwell Creek Bridge showing where each paint system was applied and Table I is a description of the coatings comprising each system. Figures 3 to 6 show the conditions of these various coating systems as of May 10, 1961.

As of the date of May 10, 1961, the best system appeared to be No. 1 (Figure 3), the inorganic chemically cured zinc coating with the complete vinyl System No. 4 (Figure 6) almost equivalent to System No. 1 in durability. The greatest failure occurred in the 100% solids epoxy coating represented by System No. 3 and as shown in Figure No. 5. It may be of significance that the application of System No. 3 was not preceded by a vinyl wash treatment. It has not been customary to use this treatment in advance of epoxy coatings.

Because of the prevailing winds and topography, the southern half of the bridge presents the most severe corrosive conditions. All systems were used in this portion of the bridge to give comparative data under conditions of an equally severe corrosive environment.

No Definite Conclusions

This report is a progress report and no definite conclusions, other than the complete failure of the epoxy coating represented by System No. 3, can be drawn for another two or three years.

The decreasing order of durability of these Systems as of the date of this report is:

System	Order
1	1
4	2
2	3
3	4



FIGURE 4—Under view of the north portion of Span 2 on which Painting System No. 2 was used.



FIGURE 5—Under view of Span 3 on which Painting System No. 3 was used.



FIGURE 6—Under view of the north portion of Span 1. Painting System No. 4 was used except on the stringer in the foreground on which System No. 5 was used.

A rating of System No. 5 is not justified because of the relatively small area to which this system was applied.

Acknowledgment

Sincere appreciation is due Robert Souza of the Materials and Research Department for the excellent photographs he took for this report and to Mr. F. N. Hveem, Materials and Research Engineer and Head of the Materials and Research Department, for his suggestions and interest in the promotion of research relative to corrosion.

TABLE I

COATINGS

System No. 1

3 mils of inorganic zinc pigment-silicate binder cured with a phosphoric acid solution, Curing Agent scrubbed off with water, Vinyl Wash Primer, State Specification 52-G-52, applied followed by 2 mils of Vinyls, State Specifications T58-G-40 and T58-G-41 in alternating coats and a final coat of 1 mil of State Specification T58-G-49, Vinyl Paint, Aluminum Finish Coat.
Total film thickness, 6 mils.

System No. 2

Vinyl Wash Primer, State Specification 52-G-52; 3 mils of Semi-Quick Drying Red Lead Primer, State Specification 58-G-53; 2 mils of White Traffic Paint, State Specification 55-G-95; 2 mils of Vinyl Paints, State Specification T58-G-40 and T58-G-41 in alternating coats; 1 mil of State Specification T58-G-49, Vinyl Paint, Aluminum Finish Coat.
Total film thickness, 8 mils.

System No. 3

Epoxy Paint, 100 percent solids, made with an epoxy resin of viscosity 40-100 poise at 25°C and an epoxide equivalent of 180-195, 20 percent TiO_2 and 5 percent Cr_2O_3 cured with an epoxy amine adduct and applied by hot spray 15-20 mils thick.

System No. 4

Vinyl Wash Primer, State Specification 52-G-52; 4 mils of Vinyl Paints, State Specifications T58-G-40 and T58-G-41 in alternating coats; 2 mils of Vinyl Paint, Aluminum Finish Coat, State Specification T58-G-49.
Total film thickness, 6 mils.

System No. 5

Vinyl Wash Primer, State Specification 52-G-52; 4 mils of Semi-Quick Drying Red Lead Primer, State Specification 58-G-53; 2 mils of Phenolic Iridescent Green, State Specification 58-G-79.
Total film thickness, 6 mils.

Vallejo-Benicia

First Section Completed On Connecting Freeway

By C. F. RODERICK, Resident Engineer



On June 14, 1961, the first section was completed for the new freeway which will connect US 40 in Vallejo with the new Benicia - Martinez Toll Bridge now under construction across the Carquinez Strait. This portion of freeway has been open for use by public traffic since December 1960 subject to a few restrictions where connecting roads were under construction. The completed portion is 3.23 miles long between Cedar Street in Vallejo and near the west city limit of Benicia.

The connecting link of the freeway between the west city limit of Benicia and the Benicia-Martinez Bridge, including the toll-gate plaza, is now under construction. All contracts are expected to be completed for opening the bridge to traffic in the summer of 1962.

The Vallejo-Benicia Freeway is in the interstate highway system and is a portion of Interstate Route 680. The US 40 freeway construction contract completed in the Vallejo area January 6, 1959, provided a full cloverleaf interchange ending at Cedar Street, which was picked as the beginning of full construction on this project. However, a ¾" open-graded contact blanket from Cedar Street westerly to Lemon Street was also a portion of this contract.

Interchange Built

Interchanges were constructed at the freeway intersections with Glen Cove Road and Columbus Parkway. Connections were made with Laurel Street on the south and Cedar Street on the north, which, with the Laurel Street Overcrossing constructed on the previous US 40 contract, provided an interchange for this area. A pedestrian overcrossing at Homeacres Avenue was constructed for the use of schoolchildren. A service road to Dillon's Point was also a part of the project.

Since the last mile of the freeway contract followed the existing Benicia Highway a detour was provided in this section by connecting the newly constructed westbound lanes of the Benicia Highway to the nearby Columbus Parkway, a county road. The freeway construction which follows the old road crosses a marshy arm of Southampton Bay. During construction of the original road considerable lateral displacement occurred as well as settlement during construction and continuing thereafter for many years. The Headquarters Laboratory Foundation Section of the Division of Highways made a study of conditions in this area before the contract was let and in the worst section (Station 180-190) a system of sand drains and earth struts were made a part of the construction contract.



Looking east on Interstate Route 680 from above the cloverleaf intersection with US 40. Immediately beyond the cloverleaf is the Laurel Street-Cedar Street interchange. Both interchanges were constructed under a previous contract.



Looking westward from the middle of the project showing the deep sidehill cut in the left foreground and the waste area on the right. The near interchange is Glen Cove Road.

Slow Settlement

The sand drains were spaced at 8 feet and 10 feet centers in both directions with varying depths of 12 to 40 feet and averaging about 25 feet. An overload of 10 feet was placed between Stations 180 and 186 and a 5-foot overload between Stations 187 and 190. The overloads were planned to remain only through the contract time but only the 5 foot section was removed. Settlement occurred so slowly in the 10-foot area it was left in place and a temporary pavement constructed over the top. It is expected the overload may be left in place for several years before it will be removed and the permanent pavement constructed.

Another location where settlement gave trouble was about 300 feet of the service road connection to Dillon Point Road. This crosses a particularly swampy section of the Southampton Bay arm. Although it has been brought to grade after settlement during the contract period, it is expected that further settlement will occur.

Trouble with ground conditions was expected in the large 40-foot to 80-foot cuts east of Glen Cove Road. Slides had occurred previously and were in evidence along the hillsides. Also, underground water had appeared in preliminary drilling operations of the Materials and Research Department of the Division of High-



A view westward on the new freeway of the Shows Homeacres pedestrian overcrossing.

ways. A pervious blanket with perforated metal pipe underdrain system was set up for this section extending east from Glen Cove Road between Stations 143 and 160. Although no free water was encountered during construction, previous experience with conditions in and around the Vallejo area influenced a decision to go ahead with the placing of the planned filter blanket and underdrains. The first hard rains bore out the wisdom of the decision for the water poured from the underdrain outlets even several days after the rains had ceased.

Slide Occurs

A slide occurred during construction in the location (Sta. 151) noted as likely in the Materials Report. The black soggy material was excavated to as much as seven feet below the eastbound lanes and up the side slope to the bench 40 feet above. A dry rock wall was built at the bottom using all of the large boulders from the excavation that could be found. Although sloughing of material above the rock wall can be seen, no movement of the roadbed has been detected to date.

During earthwork operations from the sand drains to the Benicia end of the project under the movements of the heavy grading equipment considerable "pumping" developed along the old highway roadbed. To insure a stable roadbed the black, mucky material was removed to a depth of four feet below grade of the new freeway and backfilled with dry stable material. Over the whole job a total of 28,000 cu. yds. of unsuitable material was removed and replaced with good stable fill in order to insure a firm foundation for the highway.

The grading on this project was not balanced, there being about 400,000 cu. yds. of wasted material out of the 824,000 cu. yds. of roadway excavation. On the plans an optional disposal area was shown north of and adjacent to Stations 150 and 169 which the contractor elected to use.

Structural Thickness

The structural thickness of the main freeway was 24" throughout the job. The subbase material was 12" in thickness, a sandy material from the sweet site located north of Benicia and about a 9-mile haul to the center of the job for the contractor. The 8" thickness of cement-treated base was plant mixed and came from the Basalt Plant in Napa. The surfacing was a 4" thickness of plant-mixed asphalt concrete which also came from Basalt in Napa. On the traffic lanes of the traveled way a ¾" layer of open-graded asphalt concrete was placed.

An extensive system of storm drains was constructed throughout the pro-



A westward view of the new freeway taken about halfway between Glen Cove Road and the pedestrian overcrossing (see previous photo).



This photo was taken from the bench of the south cut slope looking west. In the foreground is the slide area at Station 151 with the rock wall at bottom left. Sloughing is in progress but no movement of the roadbed has been detected to date.



Settlement cracks in the earth strut along the north side of the sand drain area caused by the overload which is applied slowly (one foot per week).

ject west of Glen Cove Road. This was a requirement due to the freeway's occupying a good portion of a natural valley in this area.

The bridge construction consisted of the Homeacres Pedestrian Overcrossing, the Glen Cove Road Overcrossing and the Columbus Parkway Overcrossing. The pedestrian overcrossing is made up of one reinforced concrete slab span and three reinforced concrete cored slab spans with a total length of 200 feet and a walkway width of eight feet. At the south end is a reinforced concrete spiral ramp cantilevered out from a central tower. The design of the pedestrian overcrossing is of pleasing appearance in spite of the necessity of enclosing the top portion with a chain link fence to prevent the dropping or throwing of objects on the roadway below.

Prestressed Girders Used

The Glen Cove Road Overcrossing and the Columbus Parkway Overcrossing are both constructed with precast prestressed reinforced concrete girders and reinforced concrete deck. They have a roadway width of a clear 28 feet and Glen Cove Road has a sidewalk on the east side. Columbus Parkway has only the safety curbs on each side. The total length of the Glen Cove Road Overcrossing is 187 feet and Columbus Parkway Overcrossing is 157 feet 7 inches long. Both overcrossings are paved with asphalt concrete surfacing. Columbus Parkway Overcrossing is supported on poured-in-place in drilled holes piling under the piers and abutments.

Frederickson & Watson Construction Company of Oakland were the prime contractors and the cost of construction was $1,725,000. M. D. Engrahm was Resident Engineer during the staking and early part of the contract, C. F. Roderick was Resident Engineer through the main portion and D. C. Willard was Resident Engineer for the final few months of the project. W. F. Fleharty was the District X Construction Engineer. For the Bridge Department George O'Dougherty was in charge for the early part and R. M. McCullough for the major part of the bridge construction. R. T. Orr was the U. S. Bureau of Public Roads representative.

Feather Lake

Highway Project Is Example Of Two Counties' Foresight

By WILLIAM D. McINTOSH, Road Commissioner, Lassen County, and
DONALD D. CHAMBERLIN, Director of Public Works, Shasta County



Among the tall pines and quaking aspen two Northern California mountain counties celebrated the completion of the 46-mile Feather Lake Highway last September.

Commencing five miles west of Susanville, the new highway runs generally in a northwesterly direction and connects State Highway 36 with State Highway 89 one mile north of Old Station.

Of these 46.1 miles of asphaltic concrete, 37.4 miles traverse the western part of Lassen County. The westerly portion drops over the Hat Creek Rim into Shasta County.

Feather Lake Highway can be described as a monument to county government at its finest, having been conceived by foresighted officials who envisioned the importance of this route to the public long before it was generally recognized.

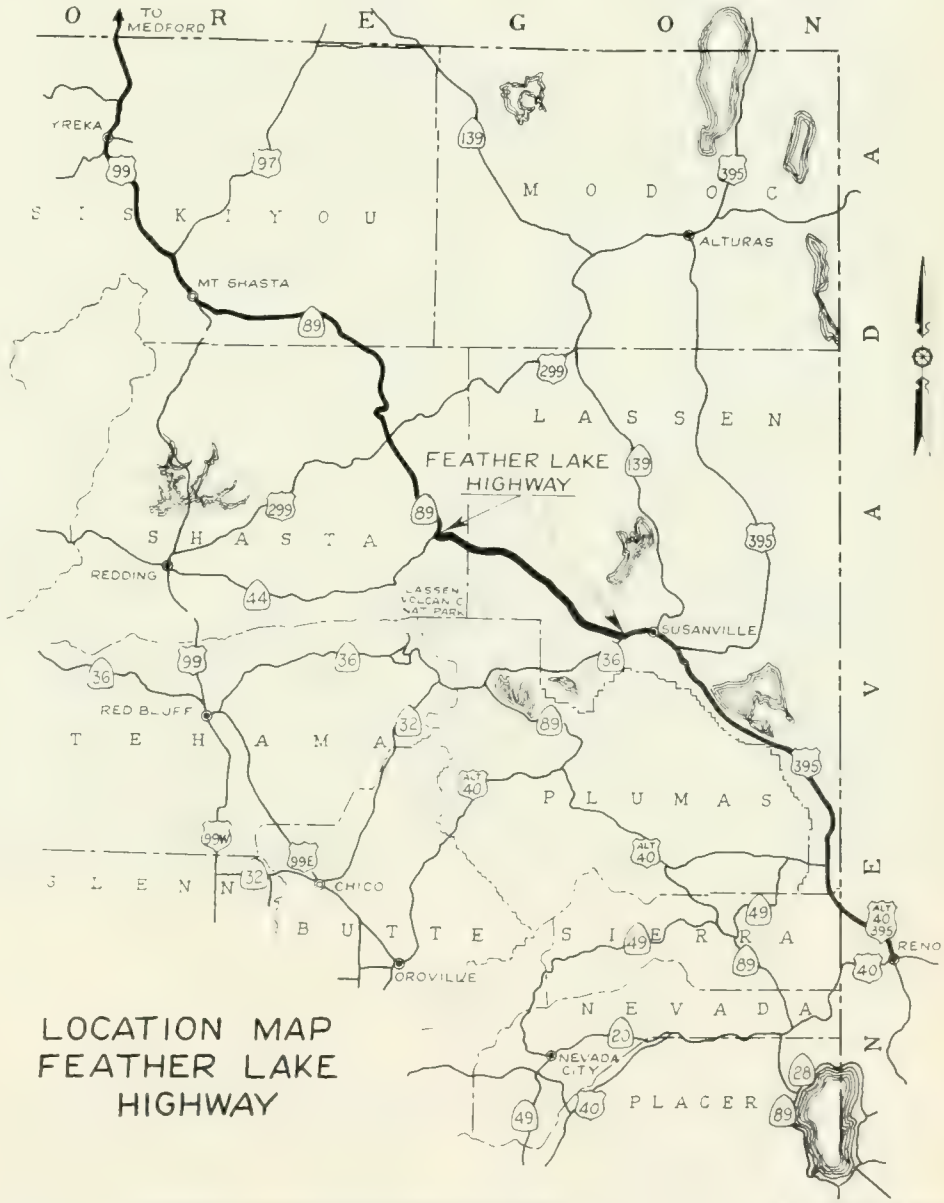
Desired for Interstate Use

The highway is a local road, but designed for and used by interstate travelers as well as California motorists. It is further distinguished by the fact that it is not the dream of the governmental body of one county, but is a result of the co-operative effort of two neighboring counties who worked together to make it a reality.

Even before the final contract was finished, travelers going west from Reno to Redding and north to Burney, Yreka, Medford, and points beyond had found the Feather Lake Highway to be a milesaver. It will also serve as an artery for timber management projects of the United States Forest Service and private timber holders; speed fire suppression over a vast area; provide access for ranches and summer pasture; and open large, heretofore untapped recreational areas in the Sierra.

Far-sightedness Borne Out

The far-sightedness of those responsible for the construction of the highway was borne out by the conclusions of the California Freeway and Expressway study ordered by the 1957 Legislature. Among the major routes designated a part of the Freeway and Expressway System was the Feather Lake Highway, which was already under construction by the Counties of Lassen and Shasta. The recommendations of the freeway study were ac-



The above map shows the location of the Feather Lake Highway and its importance as a connecting link of the State Highway System.

Seattle Public Library
MAR 20 1962



The new Feather Lake Highway with the Western Pacific Railroad crossing in the foreground, Anna Lake at right center, McCoy Flat Reservoir in the background and beyond that, in the far distance, Hog Flat Reservoir.

cepted and enacted into law as the California Freeway System by the 1959 Legislature.

The alignment of the Feather Lake Highway follows part of the "Pioneer Freeway System." In 1848 Peter Lassen, an early pioneer responsible for settling portions of Lassen and Shasta Counties, used a portion of the present route to transport new settlers from the East.

First Interest Shown in 30's

The Bureau of Public Roads and the United States Forest Service first showed interest in the route in the 1930's, but it wasn't until Lassen and Shasta Counties took the initiative in 1957 that continued progress was actually accomplished. It was in that year that the two counties placed the route in the Federal-aid Secondary System and programed a schedule of continuous contracts to complete the project. A total of 11 contracts amounting to $2,670,000 were awarded to construct the highway; six by the

. . . *Continued on page 35*

42-year Veteran Bill Bock Retires

William Bock, Assistant Office Engineer for the State Division of Highways Headquarters in Sacramento, retired in January, ending 42 years with the State.

For many years Bock was in charge of reviewing and co-ordinating plans and contract specifications as the final stage of preparing a highway project for bid advertising.



WILLIAM BOCK

After bids have been opened and contracts awarded, he has been responsible for review of progress payments to the contractor during the course of the job and the final payment upon completion.

Many of the division's procedures in contract administration were developed under Bock's guidance.

Among his other duties were responsibility for the production of the annually revised State Highway Map which is part of the division's annual report, and the supervision of the preparation of title sheets for contract plans and maps showing route adoptions by the California Highway Commission.

Among highway engineers Bock is noted for his excellent memory. He is widely known as a source of ready information concerning hundreds of highway contracts, both past and present.

Bock joined the division as a draftsman in 1919. In March, 1920, he left to become Assistant City Engineer of Tracy, but returned to state service in November of that year.

From 1922 to 1923 he was assistant resident engineer on highway construction projects in Bakersfield and Fresno. He moved to Sacramento to join the Office Engineer's staff in 1923.

Bock was born at Galt, Sacramento County, and attended school at Altamont. He holds an associate of science degree from the Polytechnic College of Engineering in Oakland.

His first professional job was as rodman and timekeeper for the Southern Pacific on railroad relocation and construction in Oregon. In 1916 he became resident engineer for the San Diego and Arizona Railroad. He left to serve with the U.S. Army during World War I.

From July to October of 1919 he was chief of party on topographic surveys for the Pit River Power Company.

Bock and his wife, Lois, have two sons: William K., of Sacramento, and Alton S., of San Jose.

FEATHER LAKE

Continued from page 34 . . .



The U.S. Post Office with its motto of "Neither rain nor snow nor hail nor sleet, etc." has nothing on the above group. Director of Public Works Robert B. Bradford (raincoat over shoulders), flanked by (left to right) District Engineer H. S. Miles, State Senator Stanley Arnold, Lassen County Supervisor "Bill" Tunison (holding oversized shears), Miss Diana Chappius, Queen of Lassen County, and Shasta County Supervisor Norman Wagoner braved a hailstorm to see that the Feather Lake Highway was properly and officially opened.

County of Lassen, one by the County of Shasta, and four by the Bureau of Public Roads using national forest highway funds. The final contract was completed in early September 1961, signalling the completion of the overall project.

The Feather Lake Highway, once merely the dream of Supervisor William Tunison of Lassen County (known as the "Father of Feather Lake Highway") and others, is now a high-standard, high-speed route through the Sierra, realizing a saving to motorists of some 29 miles between Susanville and Redding, the two county seats, or 74 miles between Reno, Nevada, and Medford, Oregon.

Highway Dedicated

The highway was ceremoniously dedicated at its easterly terminus on September 17, 1961. At that time a joint resolution adopted by the Counties of Lassen and Shasta, offering the route to the State Department of Public Works as a completed section of the California Freeway and Expressway System, was presented.

The route was accepted for State maintenance on September 27, 1961, by the California Highway Commission and is now officially designated State Sign Route 44. On January 25, 1962, it was adopted by the Highway Commission as a freeway route. No one could be more justly proud of this accomplishment than the officials of the two small counties who were primarily responsible for the completion of such a monumental and worthwhile project.



Cross section of Yerba Buena Island tunnel, San Francisco-Oakland Bay Bridge, looking east as originally constructed. Lower level right used by electric interurban lines, lower level left for commercial vehicles. Upper level six lanes of passenger car traffic.



When train service discontinued by Public Utilities Commission order; tracks were removed as first step in reconstruction, and area paved. As yet no change in motor vehicle traffic pattern.



Truck lanes lowered to level of of south lanes, and center wall between columns removed. Four lanes of traffic now available for lower level traffic. No change on upper deck at this stage.

Bay Bridge

Second Phase of Reconstruction Nearing Completion

By N. C. RAAB, Chief Projects Engineer,
Division of San Francisco Bay Toll Crossings



In the July-August 1960 issue of *California Highways and Public Works* magazine the first phase of the reconstruction of the San Francisco-Oakland Bay Bridge was described. That article dealt with the San Francisco approaches to the bridge, the conversion of the Transbay Transit Terminal from train to motor coach operation and the paving of the lower deck area over the West Bay crossing, formerly occupied by the bridge railway, for all vehicular use.

This article pertains to the paving of the East Bay crossing; the reconstruction of the roadways through the Yerba Buena Island Tunnel; the viaduct section on the Island; and the strengthening of the West Bay upper deck floor system to accommodate the heavier commercial vehicles.

110,000 Vehicles Daily

The planning for all contracts, in connection with the reconstruction of the bridge, provides for the more than 110,000 vehicles per day crossing the structure without serious delays. Specifications are so worded that construction is carried out on a calendar day basis, which calls for work to be performed outside the normal eight hour day and on weekends.

The present upper deck of the bridge has six 9′-8″ traffic lanes, three in each direction, for automobile traffic only. The lower deck originally had a 31-foot roadway, three 10′-4″ lanes for commercial vehicles. The remaining 27 foot width on the south side was occupied by the railroad.

Upper Deck Strengthening

The plan for strengthening the upper deck to accommodate five 11′-7¼″ one-way vehicular lanes for mixed traffic required the analysis of the present floor system to determine which members were deficient in strength and a practical means of reinforcing those parts not meeting specification requirements.

The completed portion of the lower deck, from San Francisco to Yerba Buena Island, was striped for five lanes. During the construction period it was operated as a four-lane roadway, two in each direction, with the fifth or south lane reserved for contractor's use.

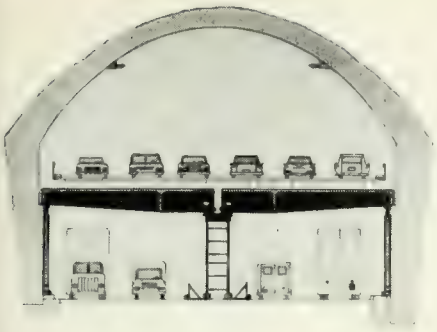
The upper deck floor system consisted of six-inch lightweight concrete slabs, 58 feet in width, supported on 13 longitudinal steel stringers, which in turn are framed into transverse steel floor beams on 30-foot centers.

Reinforce Floor Beams

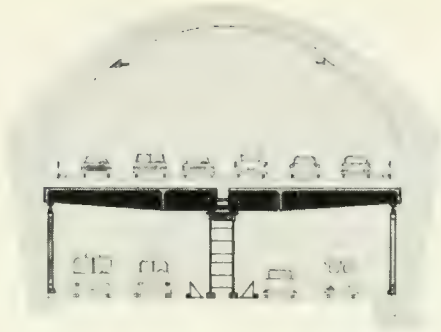
The theoretical analysis of the floor system revealed the adequacy of the concrete slab with its steel reinforcing to support the heavier commercial vehicles, and the same was true of the steel stringers. The floor beams were found to be deficient in strength and required reinforcing.

Due to the many assumptions that are applied in the theoretical analysis of a problem which could materially influence the results, it was decided to verify these findings by field tests using a loaded truck which imposed upon the concrete slab the legal loading concentrations.

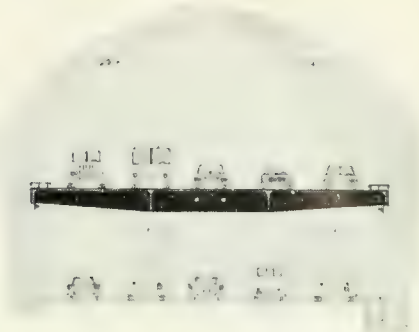
Four floor beams were selected for tests, each with different framing and loading characteristics. Instrument readings were taken of all floor mem-



Next step is lowering of upper deck roadway for better clearance in tunnel, and removal of center supports obstructing repaved lower roadway. Since upper deck must be replaced in sections, traffic moves over portion of upper roadway that is removed by means of a temporary bridge which is moved forward as new precast deck units are replaced in gap at lower elevation.



New deck units are put in position, one side at a time, while truck traffic is transferred to whichever alternate lanes not occupied by construction crews. After positioning, units are tensioned and center gap is filled with concrete.



When all units are in position, columns on lower level have been eliminated. Traffic pattern is now changed to five standard width lanes for mixed traffic; one-way, on each level. Lower level is eastbound, upper level is westbound.

bers before and after test loads were applied.

The results of the tests proved that existing conditions under actual loads were better than the results obtained by the theoretical calculations. It also demonstrated that the method of strengthening the deficient members was practicable and could be achieved under adverse working conditions.

The plan for strengthening the 357 floor beams required a high strength steel plate attached to the lower flange of the member after the plate was stressed to a predetermined amount. By tensioning the new cover plate a compressive stress was induced into the lower flange of the floor beam, resulting in a reduction of the dead load tensile stresses. The tensioning was sufficient to prevent an overstress of the composite flange under legal axle loading.

Traffic Continued

As this construction was done under traffic, the contractor was furnished three of the State's traveling scaffolds which are supported on tracks suspended from the upper deck. These were augmented by lighter platforms which the contractor fabricated and erected. The material was handled from the south lane provided for the contractor's use.

The operation in general consisted of drilling holes through the lower flange of the floor beam, bolting one end of the plate to the flange, stressing the free end of the plate by jacks, locking the stressing device, then drilling bolt holes through the lower flange using the stressed plate as a template, and then bolting.

High strength body bolts were inserted in the holes and the nuts tightened with a wrench to a specified torque. Stitch bolts were placed throughout the length of the plate to hold it in position.

Also included in this contract was the widening on both sides of the upper level roadway between the San Francisco Anchorage and Pier W-1 from 58 feet to 69 feet. This widened portion will eventually be incorporated into deceleration lanes and refuge bays for the "off" ramps on the north and south sides of the deck leading to Fremont Street in San Francisco, when the bridge becomes one way westbound.

On completion of the contract, the West Bay crossing will be completed and ready for five lanes of one-way mixed traffic on each deck when traffic is changed to this operation, starting the early part of 1963.

Yerba Buena Island Construction

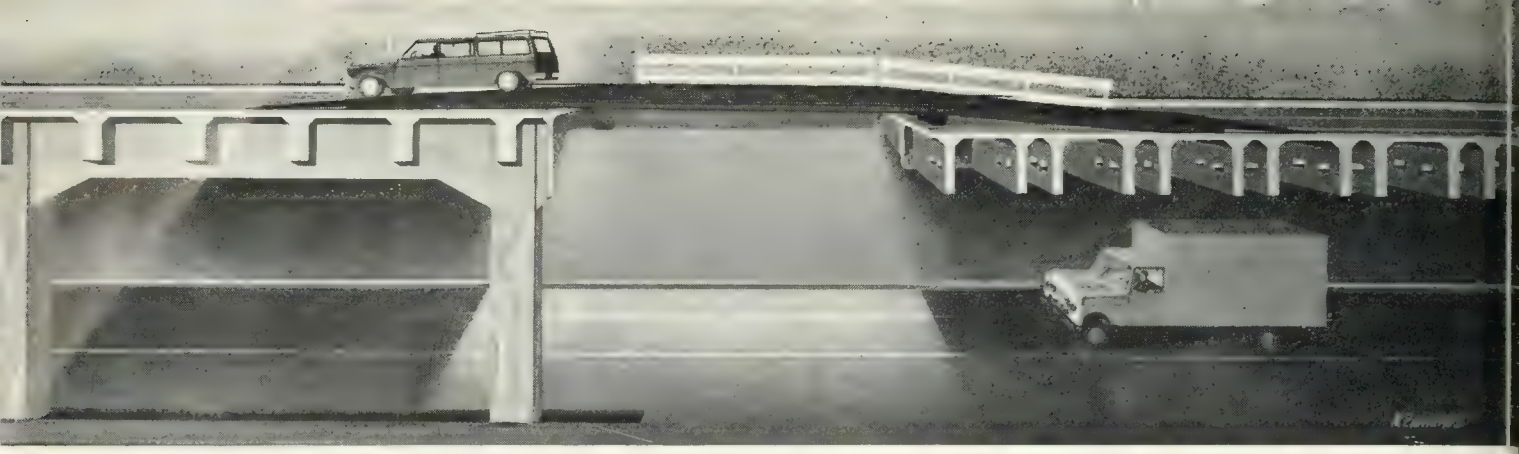
Probably the most exacting and difficult construction operation being completed is the work now in progress across Yerba Buena Island in connection with the San Francisco-Oakland Bay Bridge Reconstruction Project. The contract extends over a length of 1,786 feet which involves 826 feet of tunnel section and the remainder in a double decked concrete viaduct.

The reconstruction in general consisted of the following:

- 1. Remove the two tracks from the south side of the lower deck area.
- 2. Lower the grade and pave the area for two lanes of traffic.
- 3. Remove the present three north truck lanes, lower the grade three feet and repave.
- 4. Restripe the north and south roadways for two lanes in each direction.
- 5. A movable steel bridge with a span of 26 feet and a width of 58 feet which fitted between the curbs of the upper level roadway was placed on the upper deck.
- 6. The columns supporting the upper deck and sections of the deck under the movable bridge, 10 to 12 feet in width, were then removed.
- 7. Precast concrete deck units, 7′-8″ in width, replaced the removed section at a 16-inch lower level.
- 8. The bridge was advanced and the operation repeated.

The upper deck viaduct section to the east of the tunnel was strengthened by the addition of precast, post tensioned, concrete units prior to the removal of the center supporting columns.

Under the south roadway a continuous concrete utility tunnel was constructed to carry the various air, electric power, water, and communication lines across the Island, which



Cutaway section of Yerba Buena Island reconstruction, with movable steel bridge in position. Viewpoint is from south, with San Francisco to left. New deck units capable of accommodating the heavier commercial vehicles at right, old inadequate upper deck floor system before removal at left.

utilities extended to both ends of the bridge.

The 58-foot roadway constructed at ground level was lowered to maintain the 16 foot minimum vertical clearance between the two levels which accommodated both the deeper deck units and the 16 inch lowering of the upper level required for clearance at the tunnel portals.

Remove Concrete At Night

The removal of some of the concrete in the tunnel section was done at night to avoid the heavy traffic on the lower deck. The precast upper deck units were erected during the day by shifting traffic on either the south or north roadways. The new precast deck units rest on shelves of the tunnel which were used to support the original upper deck.

Forty-eight Hour Cycle

The tunnel units arrived at the site in two sections. Each section was raised and placed in position by an elevator hoist mounted on a truck. One end of the section rested on a shelf and the other on falsework struts along the center line of the tunnel. The units were post tensioned after connecting the high strength steel rods at the center and then jacking the two sections apart. The 1′-6″ gap between units is closed by a steel form, filled with concrete and then heat cured. The operation was based on a 48-hour cycle before traffic was allowed on the new roadway. Lightweight concrete was used in the units as well as the key forming the two parts into a single roadway section.

A sprinkler system with fusible metal plugs in the nozzles was suspended from the upper deck in the tunnel section for fire protection. A fire patrol station is automatically notified as soon as water starts flowing through the sprinklers.

Various island roadway connections to the bridge were necessitated to accommodate traffic during the construction period and for the final routing of unidirectional traffic on each level.

Also required by the change are passenger platforms for island personnel using public transportation to the mainland. The platforms are located opposite each other on the east side of the tunnel, one on the north side of the upper deck and the other on the south side of the lower level. The roadway has been widened to six lanes at the platforms which provides for a deceleration and acceleration lane for buses stopping at these stations.

Roadway Lighting

The roadway lighting for the upper and lower decks was a part of this contract and consisted of some rearrangement of the sodium vapor lights on the upper level where new roadway connections and passenger platforms require a change.

The lower level lighting was entirely new throughout the 1,786 foot length of the reconstruction which consisted of continuous lines of fluorescent fixtures on each wall of the tunnel section and separately spaced units on each side of the viaduct.

The lighting circuits are so arranged to have all the tunnel lights on during the daylight hours and half the number during the night. This light arrangement will be synchronized with the viaduct section.

Mechanical ventilation for the two roadway areas in the tunnel was considered during the reconstruction planning stages. The cross section area of 1,500 square feet of the upper level is large compared to vehicular tunnel or tubes where artificial ventilation must be considered for the comfort of the users. There has never been any noticeable or disagreeable effects from motor fumes on the upper level through the tunnel, probably due to the short (540 foot) length and favorable scavenging action of the air currents.

Lower Level Vented

The lower level has a cross sectional area of 1,000 square feet, two-thirds that of the upper area. The lower section does not have a free flow of air, and there could be some ill effects due to this. Provisions for the release of any accumulated fumes was considered in the planning and vents are placed at 7′-8″ centers under the sidewalk. The free flowing air through the upper section should siphon most of the gasses from the lower roadway.

If this does not prove to be an effective means of clearing the vitiated air, after one-way traffic is established, it has been planned to use the utility duct to convey and release fresh air along the lower roadway. Automatically operated electrical blower equipment would be housed in an existing vault at the east end of the tunnel.

Lower Deck Paving—East Bay

The removing of the railroad rails and paving of the area occupied by trains along with other reconstruction work on the East Bay crossing of the San Francisco-Oakland Bay Bridge was performed under another contract.

The decking operation consisted mainly of the following:

- 1. Removing of tracks and appurtenant material.
- 2. Saw cutting the concrete and removing approximately one foot of the truck pavement in the south truck lane to the center of the first highway stringer.
- 3. Remove the center steel barrier to the south truss of the bridge.
- 4. The various utility facilities were hung on the back wall of the barrier.
- 5. The railroad stringer bracing which was no longer required for the highway construction was removed.
- 6. New steel maintenance platforms were hung from the south truss at the lower deck level at specified locations with steel ladders leading to the upper deck.
- 7. Precast roadway deck units were placed, fastened to railroad stringers and joined by a concrete fill.

Tracks Removed

All track material was removed over the existing railroad, segregated and then stored in the proper bins or stacks in the East Bay storage yard. The material was held for disposal through contracted sales.

A one foot width of the lower deck adjacent to the center barrier was notched with a concrete saw. The concrete was broken out to the center of the highway stringer which provided a seat for one of the four lightweight concrete slabs that were placed in each panel.

The longitudinal steel bracing between the railroad stringers was removed to reduce the dead load and the maintenance painting of these parts. The converted railroad stringers are now braced by the continuous concrete deck slab which the stringers support.

The new deck units, approximately six feet in width and with lengths to fit the various panels were trucked to the site, lowered into position on the railroad stringers and then joined together by high early strength concrete.

Before the innermost panel was placed, the steel barrier which is composed of a curb and wall was skidded over the railroad area to its new position along the south truss of the bridge. After adapting and fastening, the salvaged barrier became the new south curb and rail for the 58-foot roadway.

Utility Facilities

The various utility facilities which consisted mainly of a four-inch pipe for compressed air and another for water, primary and secondary electric power cables, and a communication line were hung on the outboard side of the rail.

Salvaged and additional working platforms were suspended from the south truss at about 300-foot intervals which provides the maintenance personnel with a safe working space for the attachment to the outlets of the various utility lines. A steel ladder leads to the upper deck from each platform for easy access to these outlets. These facilities are in turn connected to the traveling painting scaffolds at or near each platform by flexible hoses and conduits. Communication to each end of the bridge can be obtained with a plug-in headset.

Precast Concrete Units

It was decided to precast the lightweight concrete deck units, transport them to the space vacated by the tracks, then set and join them together at each stringer with a high early strength concrete for the following reasons:

- 1. A poured-in-place slab would have required the inboard truck lane during the pouring and curing stages, thus cutting the lower deck roadway to two lanes.
- 2. There would be some doubt as to the strength of the concrete in certain areas of the bridge due to the excessive vibration of the structure.
- 3. The high early strength concrete used to connect the units together along the stringers does not require the strength that is needed in the slab.

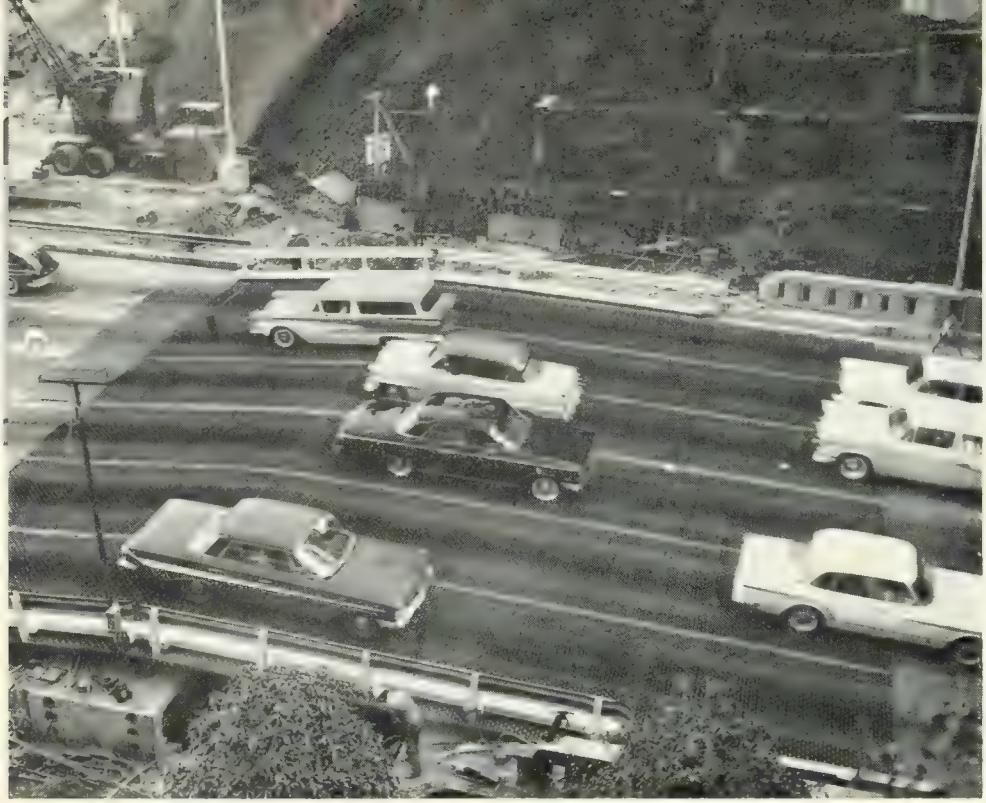
East End of Bridge

The east end of the bridge presented several problems which resulted from the location of the columns supporting the upper floor system, and the separation of the railroad structure from the highway ramp where they



Photograph of movable bridge from viewpoint on same side of bridge as cutaway section of tunnel reconstruction. Outer ends of new deck units are seen in right foreground. The prefabricated, prestressed units fit neatly together, and no additional decking is necessary.

Beneath 90,000 Cars a Day



Above: Looking down from slopes at east entrance to tunnel, Yerba Buena Island, showing traffic crossing movable steel bridge. Many caution signals were posted and speed limit across movable bridge was reduced to 15 mph.



Left: View through lower level of tunnel, showing center columns to be removed. Construction crews are working in back of camera. Light lines far side of columns are lights of vehicles moving through tunnel over paved area which was once occupied by railroad.



Double mounted air hammers, one vertical and the other horizontal for breaking out upper deck and columns. View shows movable steel bridge left and old reinforcing right. Workman is cutting away reinforcing steel with torch.



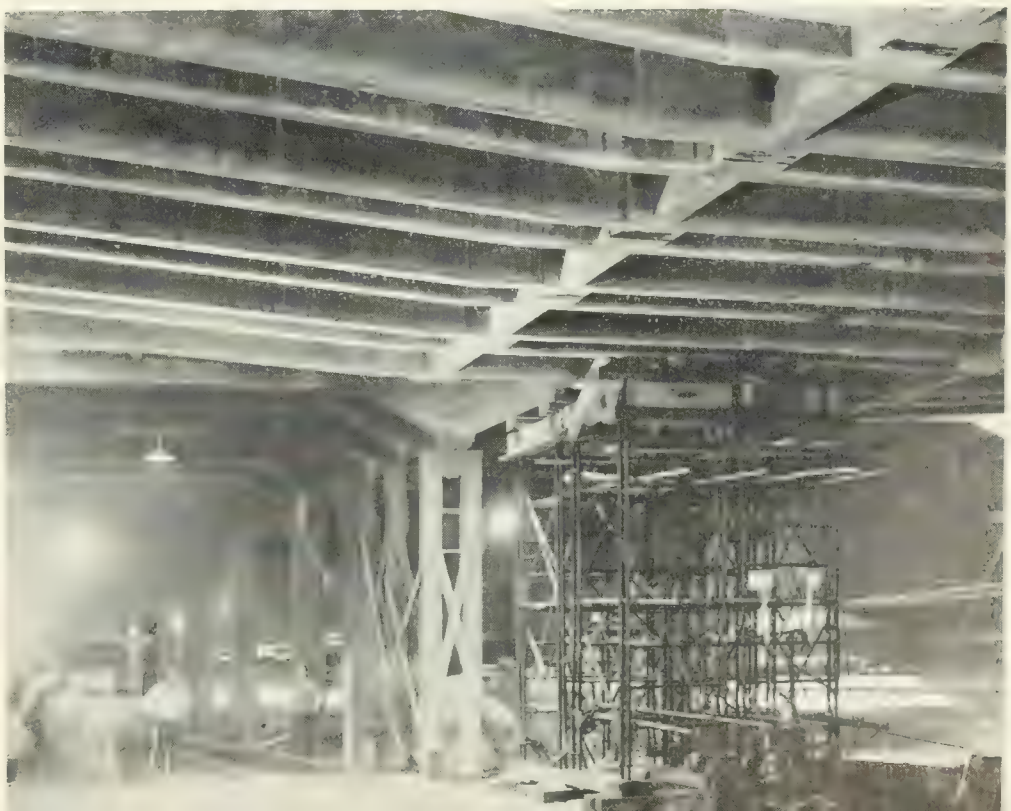
Huge precast concrete unit removed from truck and placed on temporary staging before lifting into position. After steel strongback is removed, crane in background places boom with special lifting platform beneath unit and positions unit in place. Men in background, upper right, are joining two previously placed right and left units.

A 48-hour cycle



Above: With unit in position on falsework, workmen rapidly clear lanes of equipment preparatory to shifting traffic. Movable steel bridge is seen above head of workman on falsework. Rectangular hole in legs of unit are for jacking struts. Ends of three high strength steel rods are protruding from end of unit.

Below: Camera facing in other direction, shows truck backing into position with another unit, traffic now moving in other lanes. In upper part of photo is seen a number of units completed, with falsework removed.



both connect to the East Bay mole at the end of the structure. It was thought advisable under this contract to strengthen the upper deck run off spans between E23 and E39, a distance of 645 feet together with the 250 feet of concrete approach, as traffic could be shifted quite readily on the lower deck roadway during this construction period.

The eastbound two-lane highway structure was connected with the railroad ramp by decking between the two roadways. Additional stringers were required to support the slab and when completed formed the five lanes that are required for Oakland-bound traffic on the south side of the mole.

Several columns that were spaced between these two roadways had to be removed which in turn required the lengthening of the upper deck transverse steel floor beams and the strengthening of these members by an additional beam. Other columns had to be constructed on the south side of the piers to support these lengthened members.

Upper Deck Adequate

The present lightweight concrete upper deck with its steel reinforcing together with the stringers supporting the deck proved adequate to accommodate the heavier vehicles.

The reinforcing for the floor beams was accomplished by a unique method of connecting a high strength steel plate girder section to the lower flange of the floor beam. The beams were fabricated with a predetermined camber, as they were of different lengths, and then placed under the floor beams. The two ends were jacked into position, causing the reverse camber of the auxiliary beam to relieve the floor beam of its dead load stress. After the new member was brought into position, the two flanges were bolted together starting from the center.

Settlement Surveys

Settlement surveys have been periodically made of the overwater piers using the permanent bench marks established in the early 1930's during the construction of the bridge. At that time the only settlement occurred during the erection of the steel superstructure, and since then the movement in the piers have been so small that it is difficult to detect with the delicate instruments required for this type of work.

The mole highway on the east end of the bridge was constructed by a hydraulically placed sand fill which was pumped into an excavated area between the bridgehead and the shore. On this fill are located the toll plaza, mole highway approach to the bridge, and a concrete cellular approach structure which has settled with the fill and piles on which it is supported.

This structure was raised by progressively jacking the end of each span a small amount and then blocking. The operation was repeated until the deck was raised to its original grade line. The traveling public was not aware of this operation.

The work under this contract started at Yerba Buena Island and progressed eastward toward the mole; however, some of the subcontracted work such as the structural steel, the electrical and mechanical construction, and other miscellaneous work was carried on in less congested areas.

Curved Sections

There are two curved sections in the east bay crossing having center radii of 1,600 and 2,000 which made the paving operation more difficult than the same work required for the West Bay crossing. There were also two curved runoff spans for the lower deck on the east end of the bridge.

This curved alignment required some specially cast deck slab units and also the addition of extra stringers to support the slab. The steel curbs and rails were replaced as chords and the roadway lanes followed the curve. The space between the south lane stripe and curb is now utilized as refuge bays.

As the deck sections were completed, the 58-foot roadway was striped for five lanes of traffic, with the south lane barricaded for the contractor's use in strengthening the upper deck for the East Bay crossing.

The remaining four lanes were used for two-way traffic during the remainder of the construction.

Electrical and Mechanical Work

A great amount of electrical and mechanical work was required during the lower deck paving contract which consisted in general of the following new construction:

- 1. Change the bridge's main power supply from 5 to 12 KV.
- 2. Provide a four-inch water line across the bridge.
- 3. Install three compressor stations to supply air for bridge maintenance purposes.
- 4. Provide low voltage electrical energy at convenient locations for maintenance forces.
- 5. Communications, control and supervisory system cables installed for more efficient bridge operation.

As the rate for electrical energy is paid on a demand basis at the point of supply, it was thought advisable to provide a service connection in San Francisco at Sterling and Harrison Streets and another in Oakland at the maintenance warehouse on the East Bay mole. A failure in either incoming service will cause the automatic power throwover in the Yerba Buena Island Substation to connect to the energized line.

The bridge's electrical requirements had about reached the capacity of the old 5 KV line and a new and better 12 KV facility distribution was needed.

Water Lines Provided

Water is required for various purposes on and at each end of the bridge. Normally the quantity is small; however, the demand could be great in an emergency. To meet the latter requirement, a four-inch water line with a metered source of supply on Yerba Buena Island extends to both ends of the bridge.

A four-inch pipe for the conveyance of compressed air was installed parallel to the water line along the lower deck railing on the south side of the bridge. Valves are provided for hose connections at each of the service platforms suspended at 240- to 300-foot intervals.

Automatic Air Supply

Air is supplied to this continuous line from the Sterling Street Substation in San Francisco, from the substation on Yerba Buena Island, and



Moving precast, prestressed concrete girders into position preparatory to strengthening upper deck supports on section of bridge east of Yerba Buena Island. Units used in tunnel are inverted-U in section, compared to this simple beam section.

the one on the end of the East Bay mole. A drop in air pressure at any of the stations automatically starts one or more of the compressors to renew the supply. The compressors in each substation are so cycled that the last to shut off will be the last in sequence to start again.

There is available at each service platform a terminal box from which 110, 220, and 440 voltages are available for the operation of maintenance and repair equipment.

One large communication cable and one multiconductor control cable run the entire length of the bridge on the south side along with the other maintenance facilities. There is available at each platform, facilities for plugging in portable telephone headset for communication with the person on duty at the administration building.

Communications and Telltales

These cables, with some of the other existing multiconductor cables extending across the bridge and connecting to an indicator board at the toll plaza, will receive the calls from persons in stalled vehicles and signals from five alarm stations. There will also be installed a supervisory system which will indicate by visual, audible and recorded means the malfunctioning of any mehcanical and electrical apparatus. Also a control system whereby various operational functions, such as lighting and signals, are remotely controlled, and a monitoring system indicating their functioning behavior.

Besides the three substations previously mentioned, there are two additional stations on the bridge, one at Center Anchorage Pier W-4 and another on the East Bay spans at Pier E-9 where transformers are installed to reduce the 12 KV voltage to the various voltages needed in the bridge operation and also the necessary switchgear to distribute the electrical energy.

The longitudinal expansion and contraction of the bridge due to temperature changes, the vertical and horizontal movements from wind, and loading conditions are provided for at various pier locations. The continuous runs of pipes have articulated joints to provide for the universal movements at these locations and the electrical and communications cables were so draped to minimize the effect of these movements.

The third and last article on the reconstruction of the San Francisco-Oakland Bay Bridge will be published at the completion of this work.

Cable Moving

New 'Skidding' Technique Saves State $146,000

By RALPH E. DECKER, Senior Highway Engineer, and
H. W. MULLER, Associate Highway Engineer



Construction of the San Diego Freeway between 0.1 mile south of 135th Street and 0.2 mile north of La Tijera Boulevard, in the Hawthorne-Inglewood area, is in progress and it is estimated that this section of freeway will be completed about March 1963.

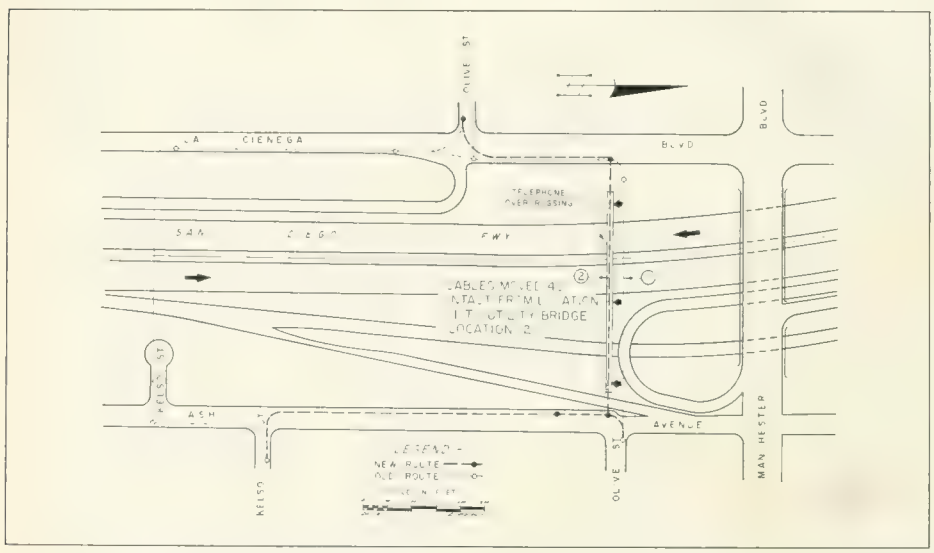
The proposed freeway in the vicinity of Manchester Boulevard in the City of Inglewood will be in cut and necessitated the construction of a bridge over the freeway at Manchester Boulevard between Ash Street and La Cienega Boulevard. This structure is now in service, having been built under an initial contract to expedite the grading and paving of the freeway by eliminating a detour for Manchester Boulevard traffic.



Multiple tile telephone duct installation in the new utility overcrossing bridge.

New Technique Employed

The procedure used to span the proposed depressed freeway with the Pacific Telephone and Telegraph Company cables, located in Kelso and Olive Streets crossing the freeway right-of-way, required the construction of a reinforced concrete utility bridge at Olive Street. This new method permitted the nine communication cables in Olive Street to be skidded intact 40 feet southerly along the ground by use of equipment and manpower and placed in the utility bridge which was constructed as a part of the previously mentioned initial freeway contract. By this new procedure uninterrupted service of the telephone cables in Olive Street was maintained. This new method, which we have called the "Transfer Intact Method," was a pioneer venture which was successfully employed on this project.



Sketch of a portion of the San Diego Freeway in Inglewood showing the former telephone cables crossing the freeway right-of-way in Kelso and Olive Streets, and the cables as relocated in the new telephone overcrossing bridge at Olive Street.

Important Cable Use

Plans for the relocation of the Pacific Telephone and Telegraph Company's underground conduit and cable installations crossing the freeway right-of-way in Olive and Kelso Street, one and three blocks respectively south of Manchester Boulevard, had to be determined during the design of the Manchester Boulevard overcrossing. The Olive Street installation consisted of nine multiple tile ducts and nine communication cables that contained more than 11,000 pairs of wires. The Kelso Street installation consisted of nine multiple tile ducts and three communication cables that

. . . Continued on page 73

San Diego Freeway

Half of 90-mile Route Completed or Under Way

By JAMES E. MARTIN, Executive Assistant, District VII



In District VII the San Diego Freeway extends from the San Diego County line near San Clemente to the Golden State Freeway near the San Fernando Reservoir, a total length of 94.5 miles. Portions of this interstate route are constructed, under construction or advertised for construction and on other sections of the route right of way is being acquired and freeway design is in progress.

The San Diego Freeway is completed or under construction in a continuous line from California Avenue in Long Beach to junction with the Golden State Freeway near San Fernando Reservoir in the San Fernando Valley, a distance of 42.7 miles.

The completion of the San Diego Freeway, from its junction with the Golden State Freeway in the San Fernando Valley to the Westminster area, a distance of approximately 60 miles, will open new travel vistas to users of the Interstate Highway System.

Substantial time and distance savings will accrue to north-south traffic through the district, as this freeway will create an effective by-pass, relieving traffic from congested city streets and conventional highways in the area through which it will pass.

1965 Completion

Preliminary estimates call for opening the entire freeway as far as Westminster by 1965; the temporary end to be at Beach Boulevard. The Pacific Coast Highway, Garden Grove Boulevard, Sepulveda Boulevard and other heavily traveled arteries, will divert large traffic volumes to the new facility. Also, newly generated traffic—that is, new trips not previously made on the freeway by any mode of travel, and area trips previously made to different destinations—will contribute to the San Diego Freeway volumes.

An estimate of traffic flow for 1965 on the San Diego Freeway indicates an average of 60,000 vehicles daily, between the Ventura and Golden State Freeways; peaking to 110,000 average daily traffic at Olympic Boulevard in Los Angeles, dropping off to 50,000 average daily traffic at the Harbor Freeway; peaking again to 75,000 per day just west of Westminster on the common roadway of the Garden Grove and San Diego Freeways, which will be a 2.1 mile, 10-lane section between Los Alamitos Boulevard and Bolsa Chica Road, where it reverts to an 8-lane facility. The 1965 estimate of San Diego Freeway traffic at the temporary end at Beach Boulevard is 35,000 vehicles.

By 1980, the target year for the completion of the freeway network in District VII, traffic volumes along the long stretch of San Diego Free-

PHOTO BELOW LEFT—Construction at Mulholland Summit, looking north. Note the relocated Mulholland Drive and Mulholland Bridge, under which the freeway will pass (bottom of photo).

BELOW RIGHT—The completed San Diego-Ventura Freeway Interchange (foreground). At the center is the temporary terminus of the freeway at Burbank and Sepulveda Boulevards.





way will have doubled, coinciding with the Southern California population and industrial expansion.

As of November 11, 1961, a total of 4,365 parcels had been acquired along the entire 90-mile route, representing an outlay of $83,754,855. Only 298 more parcels, estimated to cost $16,065,478, remain to be acquired to complete the right of way program for the San Diego Freeway. A complete right of way cost and construction breakdown is given in the accompanying chart.

RIGHT-OF-WAY COST

SAN DIEGO FREEWAY	TOTAL		TO DATE 11-30-61		TO GO	
	Parcels	$Cost	Parcels	$Cost	Parcels	$Cost
Los Angeles County						
174th Street (Artesia to Golden State Freeway)	3,505	60,748,769	3,443	55,941,158	62	4,807,610
Main to 174th	213	4,770,763	211	4,490,489	2	280,274
Alameda to Main	73	1,866,327	69	1,668,923	4	197,403
Studebaker to Alameda	564	18,057,624	471	15,306,372	93	2,751,252
Orange County Line to Studebaker	52	823,765	47	735,413	5	88,352
Orange County						
Santa Ana Freeway to Los Angeles County Line	256	13,553,087	124	5,612,500	132	7,940,587
Total	4,663	99,820,335	4,365	83,754,855	298	16,065,478

(These figures do not include overhead costs since July 1, 1961)

CONSTRUCTION COST

ROUTE 158	Expended to date 12/13/61	$199,420,000 (R/W & Constr.)	
	Completion Date	Construction Cost	Miles
60-61 Fiscal Year			
Route 4 to Burbank Boulevard	(gr)	$3,345,000	8.9
62-63 Fiscal Year			
Route 4 to Burbank Boulevard	1-64 (pav.)	8,300,000	—
Burbank Blvd. to Valley Vista	7-3-58	2,800,000	1.3
Mulholland Bridge and relocating of Mulholland Drive	4-1-60	1,824,000	—
Valley Vista to Casiano Road	10-26-62	19,650,000	5.6
Casiano to Ohio	6-23-57	4,641,000	2.0
Ohio to Venice	2-19-57	6,440,000	3.5
Venice to Jefferson	7-14-60	5,371,000	1.8
(Manchester to Vesta) (Br.)	4-19-62	1,633,000	—
(Manchester) (3 Br.)	2-1-61	421,000	—
Jefferson to La Tijera	3-27-63	4,730,000	1.5
La Tijera to 135th	2-21-63	11,637,000	4.7
135th to Hawthorne	1-28-63	4,533,000	2.0
Hawthorne Boulevard to 174th Street	6-4-62	3,313,000	1.1
174th Street to 190th Street	8-8-62	7,048,000	3.4
190th Street to Carson Street	4-25-62	7,070,000	2.7
Carson Street to Alameda	6-22-62	4,322,000	1.9
Alameda to Long Beach Freeway	1-23-62	5,134,000	1.1
61-62 Fiscal Year			
Long Beach Freeway to California	10-11-63	7,820,000	1.6
62-63 Fiscal Year			
Atlantic to Orange County Line	9-64	14,000,000	5.9
(Lakewood to Cherry)	2-5-62	1,437,000	—
(Studebaker to Cherry)	2-25-63	3,423,000	—
(Clark to Lakewood)	1-9-63	1,299,000	—
(Willow to Lakewood)	3-14-60	154,000	—
ORANGE COUNTY			
0.6 mi. E. Bolsa Chica to Los Angeles County Line	9-64	9,000,000	4.8

Completed Projects

Sections of the San Diego Freeway have been constructed in Orange County since early 1958, when the first unit of 1.6 miles was completed at a cost of $665,000 from junction with the Santa Ana Freeway near El Toro Marine Corps Air Station to Niguel Road.

On September 22, 1959, a 7.5-mile section, costing $4,218,000, was completed from Niguel Road to Trabuco Creek, where it joins another 3.7-mile section through San Juan Capistrano completed on December 24, 1958, under $4,081,000 contract. Another San Diego Freeway project through San Clemente to the San Diego county line, 1.8 miles, was completed on October 20, 1958, at a cost of $2,413,000. On December 1, 1960, a connecting link was completed between San Juan Capistrano and San Clemente, adding 5.8 miles of freeway at a construction cost of $6,358,000.

Previously completed major contracts on the San Diego Freeway in Los Angeles County, in south to north order, are as follows: Jefferson Boulevard to Venice Boulevard, 1.8 miles, $5,371,000, July 14, 1960; Venice Boulevard to Ohio Avenue, 3.5 miles, $6,440,000, February 19, 1959; Ohio Avenue to Casiano Road, two miles, $4,641,000, under two contracts in 1957; Mulholland Drive Bridge and Relocation, $1,824,000, April 1, 1960; and Valley Vista Boulevard to Burbank Boulevard, 1.2 miles, $2,800,000, July 3, 1958.

Minor contracts financed in the 1961-62 Highway Budget include median barriers and signs from Jefferson Boulevard to Casiano Road north of Sunset Boulevard, 7.2 miles, $190,000; landscaping, between Venice Boulevard and Charnock Avenue, 0.2-mile, under $18,640 contract scheduled for completion in July, 1962; functional planting, Avenida Allesandro to connection with Pacific Coast Highway in San Clemente, 7.1 miles, $152,000; and storm drain chan-

nel, Westminster Avenue to Springdale Street, 0.4-mile, under $166,750 contract scheduled for completion in March, 1962.

Some of the minor San Diego Freeway projects recently completed are as follows: landscaping, Burbank Boulevard to Ventura Boulevard, April 26, 1960, $95,000; landscaping, Wilshire Boulevard to Matteson Avenue, April 28, 1960, $164,000; landscaping, Slauson Avenue to Venice Boulevard, December 15, 1961; and bridge and approaches, Willow Street to Lakewood Boulevard, March 14, 1960, $154,000.

Oil Well Abandonment

Before construction could be undertaken on the San Diego Freeway in the Long Beach area between the Los Angeles River and Walnut Avenue (overlaps construction now in progress between California Avenue and the Long Beach Freeway), about 95 abandoned oil wells in the Long Beach (Signal Hill) Field had to be capped and reabandoned under five right of way clearance contracts, the last of which was awarded on July 26, 1961. Combined cost of the projects: $451,191.

Long Beach Oil Field

From information supplied by John B. Sansone, Senior Exploitation Engineer, Shell Oil Company, the Long





Embankment construction on the San Diego Freeway in the San Fernando Valley. The view is northward from Hart Street with the Sherman Way interchange at the center.



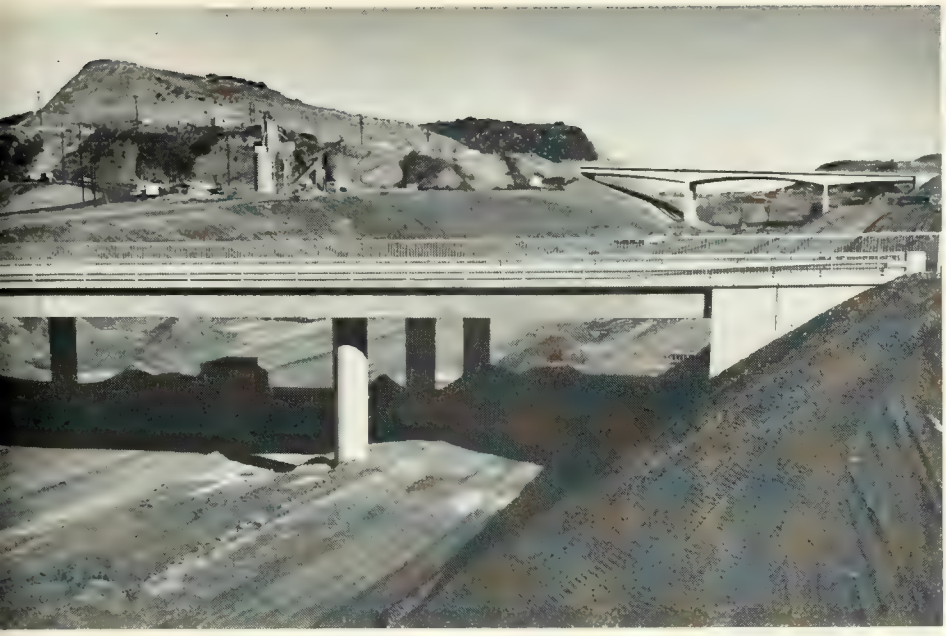
Closeup of hauling operations within the Mulholland Cut. Note the developing slide area at top right.

Beach oil field is described as an area about five miles long by one-half mile wide. It is a faulted anticline, elongated to the northwest. The dominant faults are the Cherry Hill and Northeast Flank. The sediments include Recent to Miocene resting on Jurassic-Triassic (Franciscan) schist basement. The field was discovered by Shell Oil Company with the completion of Alamitos No. 1 on June 25, 1921, with an initial flow of 590 B/D, 21.3° gravity oil, 0.4% cut, producing from the interval 2,729-3,114 feet. It took 90 days to drill with cable tools. This well is still pumping 2 B/D oil and 1 B/D water. To date the well has produced approximately 700,000 barrels of oil. As of January 1, 1960, only two fields in the entire State of California had produced more oil than the Long Beach Field (817,954,000 barrels). The Long Beach Field, with an estimated recovery of 525,000 barrels per acre, has the distinction of having produced to date more oil per surface acre of any field in the United States and probably the world. This is due to the fact that the field is actually a series of fields superimposed upon each other, and because of the density of wells drilled on a relatively small surface with multitudinous ownerships (town lots). The field, with the exception of the Airport Area Pool, represents a view of the past in development. It is now what is commonly referred to as a "stripper" field. Derricks and much of the pumping equipment are obsolete.

First Contract

The first contract for re-entering and reabandoning oil wells within the San Diego Freeway right of way was accepted as completed by the State Highway Engineer on August 1, 1960, and the construction cost was $123,017. Since this was the prototype project, it will be discussed in some detail.

The work consisted essentially of locating the wells, preparing the sites, rigging up and drilling out the well to below the shoe of the surface casing, underreaming a 36-inch by 25-foot section below the shoe of the surface casing, pressure cementing cement slurry plugs, cutting and pulling the surface casing from a point



Completed bridge structures on the San Diego Freeway at Mulholland Summit. Upper structure is Mulholland Drive Bridge. Top left is reconstructed Sepulveda Boulevard.

below the proposed roadway subgrade elevations, and general cleanup.

The wells were located using a ¾-cubic-yard truck crane equipped with a clamshell bucket. Although the old locations secured from available records were incomplete and at times misleading, one could, by observing the ground strata and buried debris, locate the wells even though some of them were found to be as much as 50 feet from the reported locations and 25 feet below the ground surface. A tractor was used to backfill the spoil banks and prepare the site for the drilling equipment.

After the well casings had been found the contractor welded on 12-inch risers equipped with flanges to which the blowout prevention equipment was bolted. Metal cellars were provided to retain any overflow of rotary mud.

The drilling equipment consisted of a highly portable rig with a 70-foot mast and a T-25 draw-works and rotary table, a positive displacement rotary mud pump, a 100-barrel mud tank with shaker screen, a caterpillar electric power unit, and various lesser equipment, tools and paraphernalia.

Junk Removed

The wells abandoned on this project were, in general, wells that had been abandoned in past years before present-day standards of abandonment were enforced. They were filled with anything and everything, including wire line, short lengths of casing and pipe, wood, rock, gravel, stones, chunks of concrete and miscellaneous trash. Removal of the junk from the wells required a lot of ingenuity. However, the contractor combined know-how with various fishing tools, including wash-over shoes, grabs, spears, magnets, jars, and milling heads to perform the programs as specified.

Probably the most difficult type of junk to remove was the wire line. The line wound around the bits and balled up so that it was necessary to cut a window in the surface casing, cut the wire with a cutting torch and remove it in small pieces. Sublin bits were used to drill the wood and debris. Tri-cone rock bits were used to drill out consolidated material.

Removal of the debris created circulation problems which were corrected by treating the rotary mud with clay to increase the specific gravity, bentonite to act as a lubricant and retain the clay in colloidal suspension, and hexameta phosphate to decrease the viscosity. The treatment provided a heavier mud than could be circulated rapidly and resulted in a successful clean-out operation.

Underreaming the 36-inch by 25-foot section below the shoe of the surface casing was accomplished using a scraper. Cement plugs were placed using a truck-mounted pumping unit capable of pumping cement slurry to any desired depth, under as much as 5,000 pounds per square inch pressure. The contractor cut and pulled the stub of the surface casing using the clamshell and cutting torch.

The contractor worked 24 hours a day, seven days a week and completed the work in less than 60 calendar days.



Construction of a huge drainage facility south of Mulholland Drive. The reinforced concrete box passes under the freeway.

PROJECTS UNDER CONSTRUCTION

Studebaker Road to Cherry Avenue

A contract started on [illegible], on a project for bridge and drainage structures between Studebaker Road and Cherry Avenue. The 2.0-mile, $3,421,700 project is scheduled for completion in February 1963. The bridges are described as follows: Studebaker Road Undercrossing, Los Cerritos Channel Bridge, Stearns Street Undercrossing, Palos Verde Avenue Undercrossing, Woodruff Avenue Undercrossing, Albury Avenue Pedestrian Undercrossing, Bellflower Boulevard Undercrossing and Los Cerritos Diagonal Undercrossing.

Clark Avenue to Lakewood Boulevard

On July 10, 1961, construction began on 0.6-mile, $1,290,300 contract for bridges between Clark Avenue and Lakewood Boulevard. Completion of this project is anticipated by January 1963. The bridges are Willow Street Undercrossing, 314 feet long, and Clark Avenue Undercrossing. Also, a 10-foot-wide by 8½-foot-deep reinforced concrete drainage facility, Bouton Creek Channel, in open and closed channel, extending approximately ½ mile, is being built concurrently and crosses under the freeway at Willow Street and at Clark Avenue.

Lakewood Boulevard to Cherry Avenue

Work began on the Lakewood Boulevard to Cherry Avenue section of the San Diego Freeway on December 14, 1960, and completion of this 0.7-mile project is anticipated by March 1962. The $1,436,395 contract is mainly for the Spring Street Overcrossing with some incidental street work. The 340-foot diagonal box girder bridge, which has eight-foot-high cells to house a 54-inch welded drainage pipe, will span the future freeway.

California Avenue to Long Beach Freeway

Construction began on December 6, 1961, on the California Avenue to Long Beach Freeway portion of the San Diego Freeway under $7,300,000 contract covering a distance of 1.6 miles. The estimated completion date is December 1963. Bridges are of the box girder and structural steel type and are designated as follows: Atlantic Avenue Overcrossing, Long Beach Boulevard Undercrossing, Wardlow Road Undercrossing, Pacific Avenue Undercrossing, Bixby Overhead, Appian Way Ramps, Los Angeles River bridges (three structural steel structures, over 600 feet long and one 811 feet long). The first order of work will be the clearing out of four oil sumps adjacent to the Los Angeles River, containing an estimated 180,000 cubic yards of rotary mud, oil, water and sand. A special feature of this job will be two utility structures, a box girder pipeline overcrossing on the east end and a box culvert pipeline undercrossing on the west end.



A helicopter in flight carrying a rail or wire.

Dominguez Channel

Since Los Angeles County Flood Control District and United States Corps of Engineers programs for control and conservation of floodwaters lie within the area traversed by the San Diego Freeway and since flood control construction has frequently been a part of freeway construction under either or co-operative agreement with the Division of Highways, it is pertinent to discuss in some detail one flood control project in particular, the Dominguez Channel, which more or less parallels the route of the San Diego Freeway from Hawthorne to the Long Beach Freeway.

Improvement of Dominguez Channel in southwest Los Angeles County is a major Los Angeles County Flood Control District project which will involve expenditure of over $21,000,000 for construction of 18 miles of flood control channel, reconstruction of 25 highway bridges and relocation of four major railroad lines as well as many other utilities.

To date, the Flood Control District has spent over $9,000,000 for permanent improvement of Dominguez Channel. Reaches have been completed between International Airport and 120th Street and Vermont Avenue and Compton Boulevard. A stretch of about one-half mile between Compton Boulevard and Rosecrans Avenue is under construction at the present time.

Bridge footings for the Anaheim Street viaduct have been underpinned to accommodate the channel improvement, and new bridges have been built at Henry Ford Avenue, Sepulveda Boulevard, Alameda Street, Carson Street, and 213th Street. New bridges at Avalon Boulevard, Main Street, and 223d Street-Wilmington Avenue are presently under construction. In addition, design of additional bridges at Figueroa Street, 182d Street, and 190th Street is under way and construction is slated to start within the next two years.

During October the board of supervisors approved plans and specifications for another reach of the channel from Henry Ford Avenue to 223d Street. Bids were opened by the Flood Control District on December 6, 1961. In order to handle construction of this four-mile section, it was necessary to relocate a network of mainline tracks of the Union Pacific Railroad, the Santa Fe Railroad, the Pacific Electric

Railway and the Harbor Belt Line Railroad plus a complex of utility pipelines and facilities.

Timetable for improvement of the remainder of the project from 223d Street to Vermont Avenue calls for its completion in about three years.

Long Beach Freeway to Alameda Street

Next in line constructionwise on the San Diego Freeway is a 1.3-mile construction project between existing Long Beach Freeway and Alameda Street. This project is nearing completion at a contract cost of $5,134,400 and was opened to traffic in mid-January 1962. Work began with the usual clearing and grubbing operations on May 23, 1960.

Two million tons of fill material was removed from a state-owned borrow site at Alameda Street and Del Amo Boulevard; another 300,000 tons was obtained from the Los Angeles County Flood Control District Settling Basin adjacent to the Los Angeles River at Carson Street. Bridges, 10 in number, are of the box girder, reinforced concrete T-beam type and precast, prestressed concrete girder type, with the Union Pacific Railroad spur being of precast, prestressed cored slab. The bridges include: the San Diego-Long Beach Freeway Interchange, Santa Fe Avenue Undercrossing, 223d Street Overhead, Terminal Island Freeway Overcrossing, and Carson Street and McHelen Avenue Undercrossings. Bridge lengths vary from 10 feet to 605 feet. Ramps are provided at the interchange, Santa Fe Avenue and Alameda Street. The contractor hauled the bulk of his fill two miles, using a 60-inch belt loader and a fleet of bottom-dump trucks (as many as 23 and 24 at a time) working two 7½-hour shifts. For compaction a special type self-propelled segmented roller was used, being equally maneuverable forwards or backwards and thus precluding turning movements.

Alameda Street to Carson Street

The Alameda Street to Carson Street section of the San Diego Freeway, 1.9 miles, has been under $4,321,900 contract since start of work on December 27, 1960.

After clearing and grubbing, 1,378,000 tons of borrow was hauled two miles from Del Amo Pit using belt loaders and bottom dump trucks. Up to 18,000 tons was hauled per one 10-hour shift at the peak of operation.

Bridges include the Dolores Yard Overhead, a concrete deck on welded steel girders 818 feet in length; Wilmington Avenue Undercrossing, a concrete box girder type 200 feet long; Dominguez Channel Bridge, a concrete T-beam bridge 438 feet in length, supported on 24-inch precast, prestressed concrete pile bents. Ramp connections are provided at 223rd Street, Alameda Street, Wilmington Avenue (full interchange), and Carson Street.

Twelve existing high pressure pipe lines, three to nine inches in diameter, had to be relocated from a suspension bridge over Dominguez Channel and housed in a new supporting structure. Structure work was by the Division of Highways and relocation by Shell Oil Company. The relocated lines pass under the freeway and over Dominguez Channel.

This contract, as well as others on the San Diego Freeway, provides nine-inch thickness truck lanes and chain link cable-reinforced median barrier. Contract completion date is anticipated by June, 1962.

Carson Street to 190th Street

The Carson Street to 190th Street section of the San Diego Freeway, a $8,120,400 contract which started on July 17, 1960, and will be completed in mid-May, 1962, has been more complicated than the adjoining jobs because of detour construction and city street revisions. There are 17 bridges, the major ones being Carson Street, 213th Street, Avalon Boulevard, Torrance Lateral (flood control), Main Street, Figueroa Street, East Connector Undercrossing (tunnel), Harbor Freeway (five bridges) and the West Connector Undercrossing (tunnel).

Under the same contract 3,000 feet of the Harbor Freeway was built as far south as Francisco Street; also built was a realigned extension of Figueroa Street frontage road on the east side of the freeway, extending one mile south of the interchange to 208th Street. Knox Street between Vermont Avenue and Figueroa Street was reconstructed along with Avalon Boulevard, which was placed on new alignment for a distance of 3,500 feet.

The general order of work required building of the Harbor Freeway section first for traffic detouring and accommodation of construction in



A helicopter hovers over the stand preparatory to picking up hose used to pump concrete for fence construction.

progress on a separate Harbor Freeway contract; after which detours were constructed for Avalon Boulevard, Moneta Avenue, Main Street, and Broadway. An eight-foot by nine-foot box was constructed at Knox Street to drain into Dominguez Channel; another 12-foot by 12-foot triple box was constructed under the Harbor Freeway, replacing a 90-inch pipe, and is an extension of the Torrance Lateral emptying into Dominguez Channel.

To further complicate matters, two dump sites were uncovered between Main Street and Avalon Boulevard, yielding 270,000 cubic yards of unsuitable material, which was distributed in selected areas over the job and covered with dirt to a depth of two to four feet. Refuse—often of a spontaneously combustible nature—was removed with scrapers, rake-attached loaders and clam bucket with fork teeth. Operations were hampered by discarded rubber tires and lengths of cable.

Imported borrow, 3,300,000 tons, was obtained from a State-owned source at Del Amo Boulevard and Wilmington Avenue. The contractor built a 40-foot wide high-speed haul road, using 60,000 cubic yards of fill, two miles long, across Del Amo Estate property. On this road he placed his scraper-hauled bottom dump truck trailers, each unit capable of carrying 60 tons at 30-mile per hour speeds. In an experimental run, he used 90-ton capacity triple scraper rigs reaching speeds of 45 miles per hour. During hauling operations, uniformed and deputized security officers worked hand-operated stop and go signals at grade crossings.

These safety precautions resulted in 3,000,000 cubic yards of material hauled without major accident or personal injury. At this writing, almost all of the bridges are completed and preparations are being made for paving.

The contractor plans to use a system of concrete haul called central mix. The concrete will be mixed wet in seven cubic yard batches and hauled by special non-agitated trucks to the construction site, where the concrete will be spread between the headers through spreader boxes. This system is expected to eliminate mixing on the job, mixers and water trucks on the grade, and the line of batch trucks waiting in front of the mixer.



Looking north along a completed section of the San Diego Freeway toward the Sunset Boulevard overcrossing (top). Note the Interstate 405 sign at the left.

190th Street to 174th Street

A connecting contract is in progress between 190th Street at the Harbor Freeway to 174th Street (Artesia Boulevard) in Torrance, 3.5 miles, at a construction cost of $7,054,200. The estimated completion date is early August, 1962. Imported borrow—from a private source at Crenshaw Boulevard and Pacific Coast Highway, a haul distance of approximately 7 miles—amounted to 3,000,000 tons and was placed in freeway fill utilizing bottom dump trucks averaging 15,000 tons per daily 10-hour shift. Other major quantities include 5,210,000 pounds reinforcing steel and 184,000 square yards concrete paving.

On this section of the San Diego Freeway the District Right of Way Department expended Chapter 20 funds in advance of the regular acquisition program in order to prevent costly development within the proposed right of way area due to rapidly increasing land values. Accordingly, between the year 1953 and 1955, 58 parcels were purchased at a cost of $1,155,465, resulting in an estimated savings to the State of $6,967,595.

Actual construction began on January 10, 1961. The job has eight bridges: 190th Street-Vermont Avenue Undercrossing, Normandie Avenue Overhead, undercrossings at Western Avenue, Arlington Avenue, Crenshaw Boulevard, 182d Street, and Yukon Avenue, and Artesia Boulevard-San Diego Freeway Separation.

Yukon Avenue and 182d Street were realigned, and at the latter location a 60-inch storm drain was constructed passing under the freeway for a distance of 700 feet and eventually emptying into Dominguez Channel. The contract provides for construction of median barrier fence of the chain link, cable-reinforced

variety. Construction operations are currently centered around placement of subbase materials and bridge work. This contract and the one north of it will be opened to traffic simultaneously when completed.

Artesia Boulevard to Hawthorne Boulevard

This $3,312,500, 1.1-mile section of the San Diego Freeway was begun on April 1, 1961 and will be completed by mid-June, 1962.

There are four bridges: Prairie Avenue Undercrossing, Redondo Beach Boulevard Undercrossing, 166th Street Undercrossing and Hawthorne Boulevard Undercrossing (350 feet long, built on a skew).

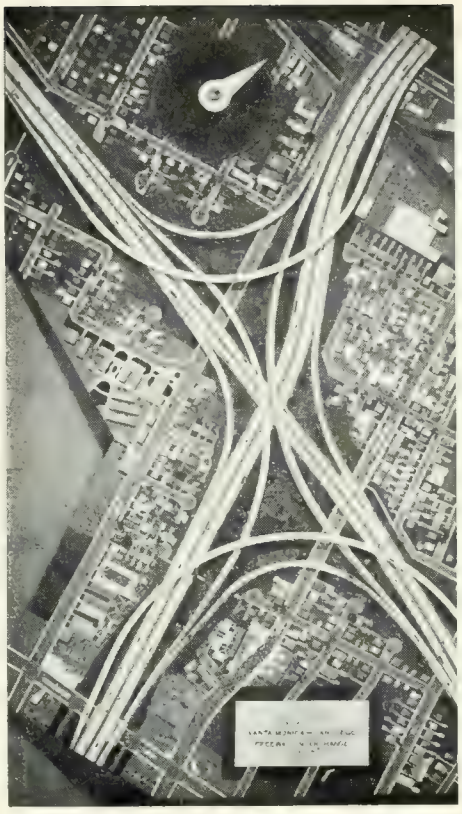
The borrow was obtained from a commercial source in the Palos Verdes Hills and hauled seven miles over city streets, utilizing bottom dump trucks averaging 15,000 tons per day. The Palos Verdes materials were considered as high quality for fill embankment, being of a coarse sandy nature. This, like other projects in the chain of contracts under way on the San Diego Freeway, has nine-inch truck lanes and median barrier fencing of the chain link, cable-reinforced variety.

135th Street to Hawthorne Boulevard

Work on this 2-mile section of freeway, between Hawthorne Boulevard and 135th Street, was started on July 19, 1961 under $4,532,350 contract.

There are five bridges: Manhattan Beach Boulevard Undercrossing, Inglewood Avenue Undercrossing, Compton Boulevard Undercrossing, Lawndale Overhead and Rosecrans Avenue Undercrossing. The 1,800,000 tons of imported borrow were obtained from Walteria Lake, located at 236th Street and Hawthorne Boulevard, a haul distance of six miles, which under agreement between the Los Angeles County Flood Control District, is being converted into a water retention sump.

A part of Los Angeles County Flood Control District Project 584 (Walteria Lake Storm Drain), the 25-acre sump has not yet been advertised for bids; but plans call for a pump station at 236th Street and the east side of the sump area which will pump water from the basin through a storm drain system and an eventual outlet at Dominguez Channel. The project is part of the $225,000,000 storm drain bond issue approved by voters in 1958.



A model of the Santa Monica-San Diego Freeway Interchange in West Los Angeles built by District VII modelmakers, Mr. and Mrs. John Unruh. The vertical roadway is the San Diego Freeway.

The contractor used conveyor belt with bulldozers in the pit and raised the material to ground level by elevator belt, where it was loaded into bottom dump trucks. The material was again transferred to carry-all scrapers and distributed over the job. At the height of operations, the contractor anticipates moving fill materials at the rate of 18,000 tons per shift.

Freeway construction also included building a flood control box structure 10 feet by 6 feet for a distance of 1,000 feet along Inglewood Boulevard and under the freeway.

This portion of the San Diego Freeway, scheduled for December, 1962 completion.

Manchester Boulevard to Vesta Street

A $1,633,000 job is in progress on the San Diego Freeway between Manchester Boulevard and Vesta Street, 0.5 mile. The estimated completion date is April 1962.

The job involves the construction of five bridges and realignment of La Cienega Boulevard. The bridges are Freeman Boulevard Overcrossing, Florence Avenue Overcrossing, the ATSF and UP double track railroad, the central outfall sewer, a six-foot diameter conduit crossing the freeway, and removal of a temporary timber railroad trestle.

Construction involved bypassing the outfall sewer line to permit overcrossing construction; it was also necessary to construct Los Angeles County Sanitation District trunk lines connecting to Vesta Street pumping plant. Construction of these lines, one paralleling the freeway on the easterly side and the other, a siphon under the freeway on the west side, necessitated trenching under the existing tracks prior to shofly construction. This work was performed during the wee hours, with stop notices to all through train traffic.

The project also included construction and extension of a Los Angeles County Flood Control District triple reinforced concrete box drainage facility leading ultimately to the Centinela Creek Channel. Sewer lines were encased. The central outfall sewer entailed underpinning the existing brick and concrete conduit prior to construction of bypass chambers. From the chambers, an 84-inch bituminous lined corrugated metal pipe was placed as a bypass line between adjacent glory hole construction. Multiple staged detour construction was required throughout. Road work involved modification of existing Pacific Electric Railway grade crossing.

The intent of this construction was to provide for routing of Florence Avenue and Freeman Boulevard traffic over the freeway path prior to construction on the big 135th Street to La Tijera Boulevard contract within whose limits this project falls.

Exceedingly complicated utility relocations were necessary on this relatively small contract. Some of the utilities concerned were Southern California Edison Company, Inglewood Water Company, Southern California Gas Company, Pacific Telephone and Telegraph Company,



A completed section of the San Diego Freeway looking north from the Santa Monica Boulevard Interchange (center).

Atchison, Topeka and Santa Fe Railroad (overhead signal lines), and Union and Mobil Oil Companies. In addition, highway and bridge lighting and signal installations were installed to conform to ultimate freeway needs.

135th Street to La Tijera Boulevard

Work started on the 135th Street to La Tijera Boulevard portion of the San Diego Freeway on July 17, 1961, under $11,601,800 contract covering a distance of 4.8 miles. The job provides for 23 bridges and two pumping plants. The bridges include: 135th Street Undercrossing; 129th Street Overhead (two structures); El Segundo Boulevard Undercrossing (two structures); 120th Street Undercrossing; Dominguez Channel Protector; Imperial Highway Undercrossing (two structures); Anza Avenue Undercrossing; Lennox Boulevard Undercrossing; 104th Street Pedestrian Undercrossing; Century Boulevard Undercrossing; Arbor Vitae Street Overcrossing; Spruce Avenue Pedestrian Overcrossing; Hillcrest Boulevard Overcrossing; Telephone Overcrossing (cable crossing); Freeman Boulevard Undercrossing; La Tijera Boulevard Overcrossing; and La Tijera Boulevard Overhead (widening existing bridge).

A dump containing some 75,000 to 80,000 cubic yards of trash was uncovered in the vicinity of La Tijera Boulevard and incorporated into other selected fill area on the job. It should be noted here that some of the fills had already been placed under a stockpiling program under which the State accepts suitable materials from other sources in advance of construction, cost free.

The main city street realignment has been La Cienega Boulevard at El Segundo Boulevard, which was reconstructed for 1,300 feet.

A part of this project is construction of the Centinela Creek Channel, in rectangular and trapezoidal sections, extending in open and closed channel from Freeman Boulevard to the northerly limits of the job. It is 25 feet wide by 12 feet deep at its maximum in the rectangular section; in trapezoidal section it measures 12 feet wide by 11 feet deep.

An unusual feature of the job is that drainage facilities have been constructed through the Spruce Avenue Pedestrian Overcrossing. A 30-inch and 24-inch storm drain, carrying surface water, passes through the structure.

The estimated completion date of this contract is March 1963.

La Tijera Boulevard to Jefferson Boulevard

Work began on October 27, 1961, on the La Tijera Boulevard to Jefferson Boulevard portion of the San Diego Freeway, 1.5 miles, at a construction cost of $5,004,400 and the estimated completion date is mid-April 1963.

The project calls for construction of three bridges, two T-girder type and one box girder, at Jefferson Boulevard, Sepulveda Boulevard, and Centinela Boulevard, the latter being the longest at 533 feet. This section of freeway will also have two nine-inch truck lanes and will be equipped with the chain link cable-reinforced median barrier.

The special feature of this job is the Centinella Creek Channel—a $1,800,000 item—which more or less parallels the freeway in open and closed channel from La Tijera Boulevard to Jefferson Boulevard, a distance of about 1.5 miles. It measures 78 feet at its widest and 33 feet at its narrowest and varies in depth from 10 to 13½ feet. Construction of the channel is by the Division of Highways based on design by the U.S. Army Corps of Engineers, who is financing the project, and under agreement with the Los Angeles County Flood Control District. This unit of the channel empties into Ballona Creek.

Complicated sewer work has also been a feature of this freeway unit. Three 78-inch sewer lines passing under the freeway at Sawtelle and Sepulveda Boulevards, a length of some 400 feet, had to be encased with 1,500 cubic yards of concrete to offset the fill load. The lines will be approximately 28 feet below the freeway grade. In addition, a north central outfall sewer, a 102-inch pipe with a 48-inch ventilation line, had to be reinforced or spanned by a concrete structure leaving air space between the pipe and the structure.

This was accomplished through the use of seven 2½-inch, 500-pound test fire hoses each 100 feet long. Utilizing 10-gauge steel plate form, the pour was made over the hoses which were then deflated and removed, leaving the huge pipe free from load.

The job also provides for realigning of 1,000 feet of Sepulveda Boulevard

and widening of Jefferson Boulevard (700 feet) and Centinela Boulevard (700 feet), including provision (stubbing off ramps and installation of extra footings) for the future Marina Freeway at Jefferson and Sepulveda Boulevards.

Casiano Road to Nordhoff Street

The largest single freeway project in the district is the San Diego Freeway job between Casiano Road in West Los Angeles and Nordhoff Street in the San Fernando Valley, measuring 5.7 miles through the Santa Monica Mountains, and 6.2 miles in the valley. The portion linking West Los Angeles with the valley at Valley Vista Boulevard entails full freeway construction, grading, structures and paving; the second portion of the job entails grading only, with pedestrian undercrossings and relocation of underground utilities and storm drain system, and lies between Burbank Boulevard and Nordhoff Street.

(This section will be completed under separate contract concurrently with the job in progress, and the 1962-63 fiscal year has financial provision in the amount of $8,220,000 to finish the 8.7-mile section between Burbank Boulevard and the Golden State Freeway in the vicinity of the City of San Fernando.)

The first half of this project, which will complete the freeway between Burbank Boulevard and Nordhoff Street, has been advertised for bid opening on February 8, 1962 (budget allocation $5,000,000). The following structures will be built: Burbank Boulevard Overcrossing; West Van Nuys Ovearhead; Victory Boulevard Undercrossing; Haskell Avenue Undercrossing; Van Owen Street Undercrossing; Sherman Way Undercrossing; Saticoy Street Undercrossing; Raymer Street Overhead; Roscoe Boulevard Undercrossing; Parthenia Street Undercrossing; Nordhoff Street Undercrossing; Plummer Street Undercrossing; Lassen Street Undercrossing; San Diego Freeway-Devonshire Street Separation; Chatsworth Street Undercrossing; San Fernando-Mission Boulevard Undercrossing, and Rinaldo Street Undercrossing.

Work started on the big contract—now estimated to cost in excess of $20,000,000—on August 12, 1960, and the estimated completion date is late 1962. The major quantities used are as follows: roadway excavation 13,000,000 cubic yards; concrete paving 350,000 square yards, bar reinforcing steel 7,000,000 pounds; six-foot chain link right-of-way fence 115,000 lineal feet; concrete in drainage structures 35,000 cubic yards; bridge concrete 14,000 cubic yards.

Four bridges and seven pedestrian subways are provided: Chalon Road Undercrossing; Sepulveda Boulevard Undercrossing (S-curve); Brownfield Drive Undercrossing; Rimerton Road Overcrossing; Sepulveda Boulevard Undercrossing (Sherman Oaks); Lemay Street, Hart Street, Valerio Street, Stagg Street, Chase Street and Rayen Street Pedestrian Undercrossings.

A $300,000 U. S. Army Corps of Engineers' reinforced concrete box drainage facility three miles long was constructed between Moraga Drive and Mission Canyon, ranging in dimension from eight feet in width and 10 feet in depth, to 11 feet in width and 11 feet in depth. It is part of the Sawtelle-Westwood Flood Control Channel, extending 9.2 miles from Casiano Road to Ballona Creek, built in seven sections during the period 1950-1961.

Six-mile Haul Road

On the north side of Mulholland Drive a 48-inch drainage pipe was constructed in the median area to drain to existing facilities at Sepulveda Boulevard. Northerly of S-curve a 1,000-foot retaining wall was erected to separate the freeway proper from existing Sepulveda Boulevard.

PHOTO BELOW LEFT—The temporary end of the San Diego Freeway (center) at Jefferson Boulevard. BELOW RIGHT—San Diego Freeway construction north from Rosecrans Avenue.







San Diego Freeway construction north from 174th Street.



Freeway fill stockpiled within the right-of-way before actual construction of the San Diego Freeway at Arlington Avenue.

As many as 55 bottom dump trucks fed by two belt loaders hauled a maximum of 15,000 cubic yards per day over a specially constructed six-mile haul road. Hauling operations took a year's time and were completed in mid-December, 1961 when all 3,000,000 cubic yards of embankment fill for the freeway between Burbank Boulevard and Nordhoff Street had been placed.

The contractor used a haul road built under previous contracts but added to it using 11 portable, assembled-in-place Bailey bridges. He also built a temporary haul bridge over S-curve and a bridge at Bromfield Canyon disposal area, and two bridges across railroads. A total of 1,750,000 cubic yards of excess excavation was distributed over the job after satisfying specified embankment needs. About 50,000 cubic yards of material was blasted, with the balance coming out under standard excavation methods.

Approximately midway through the job an instability developed in the Mulholland Summit area within the roadway prism, requiring a change in construction plans. It was necessary to flatten and buttress the slopes and increase the existing 4½ percent grade to 5½ percent by raising the roadbed 80 feet. (A financial allocation by the California Highway Commission, made on December 13, 1961, in the amount of $2,100,000, meets this contingency.) Stabilization of the slopes will also require emergency acquisition of additional right of way on the east and west sides of the Mulholland Cut, and negotiations are currently in progress for the purchase of the needed properties. Construction is in progress beneath existing Mulholland Drive Bridge carrying relocated Mulholland Drive over the freeway. The earth fill falsework, placed there under earlier contract in building the columns, which are 90 feet from the foundations to the bridge soffit, is being removed. This operation, interestingly, gives the appearance of uncovering a finished bridge buried in the ground.

It should be noted that existing Sepulveda Boulevard south of the tunnel was relocated and reconstructed throughout, in connection

with freeway work, and that normal traffic flow (approximately 40,000 motor vehicles per day) was maintained during the course of construction.

Operation Sky-hook

Erecting the 72-inch chain link right of way fence along the slopes of Sepulveda Canyon posed a host of problems for the subcontractor who bid the job. The slopes are rugged and high, and accessibility difficult. The first order of work was to clear the scrub and trees from the fence line and this was accomplished.

However, there was the task of transporting the concrete for the fence post bases, which proved to be impractical, and at some locations impossible, by hand. A solution was reached in the form of a transit mix truck and a concreting pump powered by an air-cooled 18-horsepower motor. It was then possible, by means of 2-inch 50-foot lengths of hose, to pump ½-inch maximum, seven-sack mix up to distances of 600 feet.

The next problem was that of transporting the fence material. For a considerable distance along the east side of the right of way, beginning just south of Mulholland Drive, it was possible, by using an existing fire road along the ridge top, to truck the material to certain forward points from where it could be carried down to the fence line.



San Diego Freeway construction at Vermont Avenue (bottom). 190th Street parallels the freeway at the left.

The fence fabric was cut into 25-foot rolls light enough for one man to shoulder. This, too, was a ticklish job because of precarious footing and the presence of rattlesnakes, four of which were killed during the first two days. It was then that the idea of flying in the material was born.

A helicoper was called into service. The first flight took place on March 31, 1961, but due to high winds and trouble with an improvised release mechanism, only a few bundles of fabric were dropped. A bomb release shackle was devised for releasing the loads, along with a raised landing platform composed of two tables and 3-inch pipe legs with space between them to hold the cargo, enabling more efficient hooking of shackle to cargo.

On the next flight a graded area near the drop sites was used and 78 rolls of fabric (4,000 feet) and tension wire were flown to the various flagged work areas. On a subsequent flight, drops were made on a mountain top. This time, in addition to the material, it was necessary to drop a roll of ½-inch 600-foot manila line and 12 steel stakes with rings welded on them, so that the fence crew could let themselves down the steep cliff by means of the rope. The crew then drove the stakes into the ground at the site of the fence posts, attached their lifelines



The San Diego-Harbor Freeway Interchange.



San Diego Freeway construction at Carson Street (center).

through the rings and dug the bases. Approximately 800 feet of 2-inch hose was airlifted at this time since it was easier to link the hoses from the top and let them down the slope to the concrete pump at the bottom.

Operation "Sky Hook" was performed with notable success and attests to the ingenuity and resourcefulness of contractor's crews and state engineers engaged in building California's freeway system.

Nordhoff Street to Golden State Freeway

Northernmost construction on the San Diego Freeway is between Nordhoff Street and the Golden State Freeway (US 6-99) in the vicinity of the City of San Fernando. It is part of a $13,383,600 contract on the Golden State Freeway, and work began on February 27, 1961. The San Diego Freeway portion represents $3,299,275 of the construction cost.

Like the freeway portion to the south, this is a "grading only" contract including a drainage system and six pedestrian undercrossings. Fill materials are being hauled for the 3.3-mile link from a state-owned source in the interchange area, amounting to 3,225,000 cubic yards. Belt loaders, bottom dump trucks and compaction equipment with a 50-ton roller are being used in the placement of the fill. The contractor has averaged 15,000 to 25,000 cubic yards per day hauling over his own constructed temporary bridges. This phase of construction on the San Diego Freeway is expected to be completed in mid-1962 at which time it will be possible to advertise for construction bids for structures and paving.

Fill Stockpiling

Prior to 1955 District VII initiated a procedure whereby a free fill is obtained for freeway embankment. However, in July 1959 a program was started to place this operation under encroachment permit and bond, issued by the Right of Way Clearance Section with inspection by the Construction Department.

The San Diego Freeway is one of several routes where fill for freeway embankments has been placed under this arrangement. Between 1958 and 1961, approximately 650,000 cubic yards of free fill was placed on the San Diego Freeway in freeway embankment, representing a savings to the State of $500,000. Fill was stockpiled at such locations as the Santa Monica-San Diego Freeway Inter-



The San Diego Freeway Dominguez Channel crossing at Wilmington Avenue.



Lowering drill pipe to cut away a section of corroded casing. The pump line (right) is used for placing cement and drilling mud.



San Diego Freeway construction in the vicinity of the Long Beach Freeway (foreground). The Los Angeles River is at the bottom.

change, and between Jefferson and La Tijera Boulevards, and between 135th Street and El Segundo Boulevard.

Material Sources Listed

The sources of the material placed by private contractors, were U.C.L.A. building excavations, Barrington Plaza Building (a 22-story apartment), and numerous major commercial buildings constructed along Wilshire Boulevard in Beverly Hills and Los Angeles. The Los Angeles County Flood Control District was also a major contributor to freeway embankment from its Ballona Creek, Centinela Creek, and Sepulveda Flood Control Channel projects.

In addition to fills placed under the free fill program, there were embankments placed on the San Diego Freeway from excess excavation available from construction in progress on the Harbor Freeway. (See *California Highways and Public Works*, May-June 1960.)

Freeway Agreements

Freeway agreements between the State and the various cities have been negotiated for 48.5 miles of the San Diego Freeway in Los Angeles County. Freeway agreements have also been entered into for the 14.6-mile portion from the Los Angeles county line to Bristol Avenue in Orange County. No agreement has yet been reached for a 9.7-mile section southerly from Bristol Avenue to the Santa Ana Freeway at El Toro; however, design is in progress and early resolution of problems on this route is anticipated. The San Diego Freeway is completed, of course, from junction with the Santa Ana Freeway at El Toro, to the San Diego county line, a distance of 20.5 miles.

Additional Moneys Voted

The California Highway Commission announced the state highway budget for 1962-63 at their October meeting in Santa Monica, voting additional moneys for this important interstate route to speed its early completion throughout. An $8,300,000 allocation will finance jobs on the north end of the freeway between Burbank Boulevard and the Golden State Freeway, 8.7 miles, which would complete construction of the San Diego Freeway in the San Fernando Valley; financing of other links in the amount of $14,000,000 will extend the freeway from Atlantic Avenue in Long Beach to the Orange county line, six miles.

Freeway Financed

Another $9,000,000 allocation finances the freeway to Bolsa Chica Road, 4.8 miles.

Other incidental financing includes allocations for tree planting, median barriers, and landscaping, on completed segments of the San Diego Freeway.

Personnel Changes

Trask Retires; Legarra, Baxter, Tinney Promoted

The retirement of J. W. Trask as Deputy State Highway Engineer—Planning, and the promotion of John A. Legarra, Assistant State Highway, to succeed him, has been announced by State Highway Engineer J. C. Womack.

Womack also announced the promotion of Frank E. Baxter, Division Maintenance Engineer, to succeed Legarra and promotion of Edward L. Tinney, Assistant District Engineer in charge of operations for District V in Stockton, to succeed Baxter.

For the past 16 months Trask has been Womack's deputy in charge of all activities involved in highway planning.

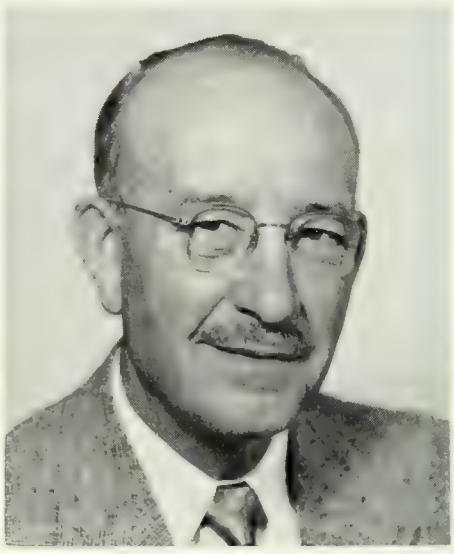
His area of responsibility has included advance planning, traffic, design, planning survey, programs and budgets and also the division's large right-of-way program.

His career with the Division of Highways began in 1928 as a junior bridge engineer and has covered



JOHN A. LEGARRA

nearly every phase of highway work. Previous to his appointment as Deputy State Highway Engineer in September 1960, Trask had been Assistant State Highway Engineer—Operations, with responsibility over the headquarters departments of construction, maintenance, equipment and materials and research.



J. W. TRASK

A native of Lincoln, Kansas, Trask was raised in Denver and graduated from Utah State University in 1922. He did engineering work for federal government agencies in the Rocky Mountain area before coming to California in 1928.

Most of his early career in this State involved bridge and tunnel construction in the central and northern areas, and then administrative assignments in division headquarters in Sacramento. One of his early assignments was as assistant resident engineer in charge of construction of the Yerba Buena Island Tunnel of the San Francisco-Oakland Bay Bridge.

Moved to District

In 1943 Trask transferred to District II, with offices in Redding, and was promoted to district engineer there in 1950. He moved to District III (Marysville) in the same capacity in 1956, and to Sacramento the following year when he was promoted to Assistant State Highway Engineer—Operations.

Trask served with the U.S. Army Engineers in World War I. He is a member of the American Society of Civil Engineers, the American Society of Photogrammetry and the American Concrete Institute. He has served on the Committees on Construction and Highway Finance of the American Association of State Highway Officials. His civic activities include membership in the California State Chamber of Commerce.

Legarra is being promoted from the position of Assistant State Highway Engineer—Planning which he has held since October 1959.

The new deputy state highway engineer was born in Marysville November 1, 1912, and attended grade and high school in Stockton. He was graduated from the University of California in 1934, with a B.S. in civil engineering, and then engaged in private engineering practice in Stockton.

He joined the Division of Highways in 1941 in the Fresno district. In 1942 he entered World War II service with the Navy Civil Engineer



FRANK E. BAXTER

Corps. When he returned to the division in 1946 he worked in the Stockton district in various capacities.

In 1951 Legarra was transferred to Division Headquarters office in Sacra-

mento as assistant traffic engineer. He also worked in the Planning and Design Departments, and was promoted to planning engineer in 1955. He continued in that capacity, except for a period in 1957 as engineer of design, until his promotion to Assistant State Highway Engineer—Planning in October 1959.

Had Active Role

In that position he has had supervision over the Planning, Design, Traffic, Planning Survey, and Programs and Budgets Departments of the Division of Highways. He has had an active role in the development of long-range planning for the State's 12,000-mile Freeway and Expressway System as designated by the Legislature in 1959, and in planning California's 2,200-mile segment of the National System of Interstate and Defense Highways under the accelerated Federal-Aid program.

Legarra is a member of three committees of the American Association of State Highway Officials: Factual Surveys, Roadside Development, and Urban Transportation Planning. He is a member of the American Society of Photogrammetry.

Baxter is being promoted from the position of maintenance engineer



EDWARD L. TINNEY

which he has filled for the past 5½ years.

Born in Los Angeles in 1907, Baxter was educated in that city and at the University of California.

In 1930, a year after his graduation, he joined the Division of Highways as an engineering aid in the Fresno district. During the ensuing 21 years he advanced to positions of increasing responsibility in that district, including district materials engineer, office engineer, and maintenance engineer.

Moves to Sacramento

In 1951 he was advanced to Assistant District Engineer—Operations for the Redding district, and in 1954 was appointed district engineer at Bishop. He moved to Sacramento headquarters in July 1956 as maintenance engineer for the division.

Baxter is a member of the American Society of Civil Engineers, and has been active on various committees of the American Association of State Highway Officials and the Highway Research Board in the maintenance field.

Tinney, the new maintenance engineer, was born in Omaha, Nebraska, in 1915 and has been a resident of California since 1926. He attended Sacramento Junior College and the University of California, and joined the Division of Highways upon his graduation in 1936. After a brief assignment in the Marysville district he was transferred to the Stockton district. He has been in that district since then, except for World War II service in the Navy Civil Engineer Corps.

His latest promotion was to assistant district engineer in July 1956, first in charge of administration and later of operations.

Tinney is a member of the American Society of Civil Engineers.

SAN MATEO-HAYWARD BRIDGE DESIGN IS APPROVED



Design work is under way by the Division of San Francisco Bay Toll Crossings for a single-deck orthotropic plate girder structure for the high-level portion of the San Mateo-Hayward Bridge as part of the over-all project to increase the capacity of that crossing of San Francisco Bay.

The California Toll Bridge Authority authorized the single-deck design at a meeting in Sacramento on January 25, 1962.

Last September the Authority had approved a double-deck truss structure for the high-level portion of the bridge where it crosses navigational waters, replacing the existing two-lane lift span. At that time the estimate of toll bridge revenue funds available for the over-all project was $65,000,000. Later figures indicated that $70,000,000 will be available, and the single-deck structure is estimated to be feasible within this latter cost range.

In the meantime, pursuant to extensive discussions of bridge designs at a meeting in San Francisco on December 6, 1961, the Authority decided to retain a special consultant. Governor Edmund G. Brown, chairman of the Authority, appointed William Stephen Allen, San Francisco architect, to this post. The Authority's action in January came after hearing a report by Allen approving the orthotropic plate girder design from the esthetic standpoint.

Allen will continue to be available for architectural consultation on all aspects of design for the structure, according to State Director of Public Works Robert B. Bradford.

Meanwhile, Chief Projects Engineer Norman C. Raab of the Division of San Francisco Bay Toll Crossings said that work is continuing on schedule on the four-lane concrete trestle section which will replace the present easterly portion of the bridge. This phase of the work is being done under a $13,278,590 contract awarded last July.

The entire project, including the new high-level structure, is scheduled for completion in 1965. Portions of the trestle will be opened to four-lane traffic earlier, however, as the work progresses westward.

Total length of the San Mateo-Hayward Bridge is about seven miles.

GOVERNOR APPROVES DRIVER HABIT STUDY

Governor Edmund G. Brown has approved a $100,000 research program to seek the causes and cures of dangerous driving habits.

The newly established Highway Transportation Agency will administer the research financed by an appropriation of the 1961 Legislature.

Governor Brown said that while "we are spending hundreds of millions of dollars building the finest, safest freeways and highways in the world, our traffic toll continues to climb year after year."

"We know a great deal about how to move volumes of traffic on our streets and highways but little about driver behavior, accident-prone locations and the effectiveness of law enforcement in preventing accidents," the Governor said.

Robert B. Bradford, Administrator of the Highway Transportation Agency and State Director of Public Works, said the research program will cover six general areas.

Series of Conferences

Details of the program were worked out at a series of conferences by officials of the California Highway Patrol, Department of Motor Vehicles, Division of Highways, the Institute of Transportation and Traffic Engineering of the University of California, and the National Safety Council.

"Some of these research studies," Bradford said, "are aimed at producing early and tangible results by which we hope to save lives right now. Others are long-range; there is no magic wand we can wave to stop the tragic loss of life and limb in our mounting traffic. The causes of this disease are deep and complex, and so are the remedies."

Program Approved

Senator Randolph Collier of Yreka, author of the legislation appropriating funds for the program (S.B. 1217) also approved the program as outlined in San Francisco at a meeting of the Senate Fact-finding Committee on Transportation and Public Utilities, of which he is chairman. He said that the appropriation will enable all agencies now doing traffic research to speed up selected important research jobs on a co-ordinated basis and thus obtain quicker life-saving results.

Six-point Program

As submitted by Bradford and approved by Governor Brown, the six-point research program and the amounts earmarked for each study are as follows:

1. $35,000 for a two-part study of "driving environment," involving a comparison of highway locations which appear similar but which have markedly different accident records and, secondly, a study of single-car accidents which in 1960 accounted for more than half of the fatal accidents on California freeways.

2. $20,000 for a study of the effectiveness of traffic law enforcement on the attitudes and behavior of drivers.

3. $15,000 for a detailed study of the behavior of identified "negligent drivers," based on the records of the Department of Motor Vehicles. Procedures for this study will be worked out by that department in co-operation with the traffic institute staff at U.C.L.A.

4. $10,000 for a study on highway system operations, with emphasis on guiding the motorist through signing and other engineering measures. The object is to prevent wrong-way operation on freeway lanes and entering a freeway on an exit ramp.

5. $5,000 for a study aimed at improving the effectiveness of acquiring and processing accident data, beginning with a conference to develop a workable research program.

6. $5,000 for developing an effective means of translating the results of safety research into safer public driving behavior.

Funds in Reserve

The remaining $10,000 of the appropriation is being held in reserve to allow for possible adjustments in the research program, Governor Brown said. Some of the planned studies may need additional funds, or one or more of several alternate studies considered by the conferees may be substituted.

Governor Brown said that Bradford will report periodically to him on the progress of the individual studies and the overall research program.

Lee Redden Retires, With State 40 Years

L. R. (Lee) Redden, District Design Engineer for the Division of Highways in District I, Eureka, retired on December 31, ending a career in state service which began 40 years ago.

Redden was born in Selma, California, and attended schools in Fresno, and the University of California at Berkeley where he obtained a B.S. degree in mining engineering.



L. R. REDDEN

Redden started as a draftsman in 1922 with the Division of Highways in Dunsmuir. Subsequently, he served in District VI, Fresno, and District V, San Luis Obispo, and came to District I in Eureka at Senior Highway Engineer in 1941.

Redden started as a draftsman in 1922 with the Division of Highways in Dunsmuir. Subsequently, he served in District VI, Fresno, and District V, San Luis Obispo, and came to District I in Eureka as Senior Highway Engineer in 1941.

During his period with District I he has been in charge of highway design work.

He and his wife, Ethel, have one daughter and two sons, and eight grandchildren. Redden's two sons are both highway engineers with the California Division of Highways, one in San Luis Obispo and the other in San Bernardino.

He plans to travel after retirement and also spend time on his hobby of stamp collecting. He is active in church work and is also a director of the Humboldt Community Services District.

Flood Problems—3

Cooperative Drainage Job Features Earth Fill Dam

By JAMES W. ROSS, Associate Highway Engineer and WAH G. CHAN, Assistant Highway Engineer



THE State Division of Highways, the Alameda County Flood Control & Water Conservation District and the City of Hayward have pooled their ingenuity and engineering ability to bring to fulfillment a co-operative drainage project that is unusual in the annals of highway drainage.

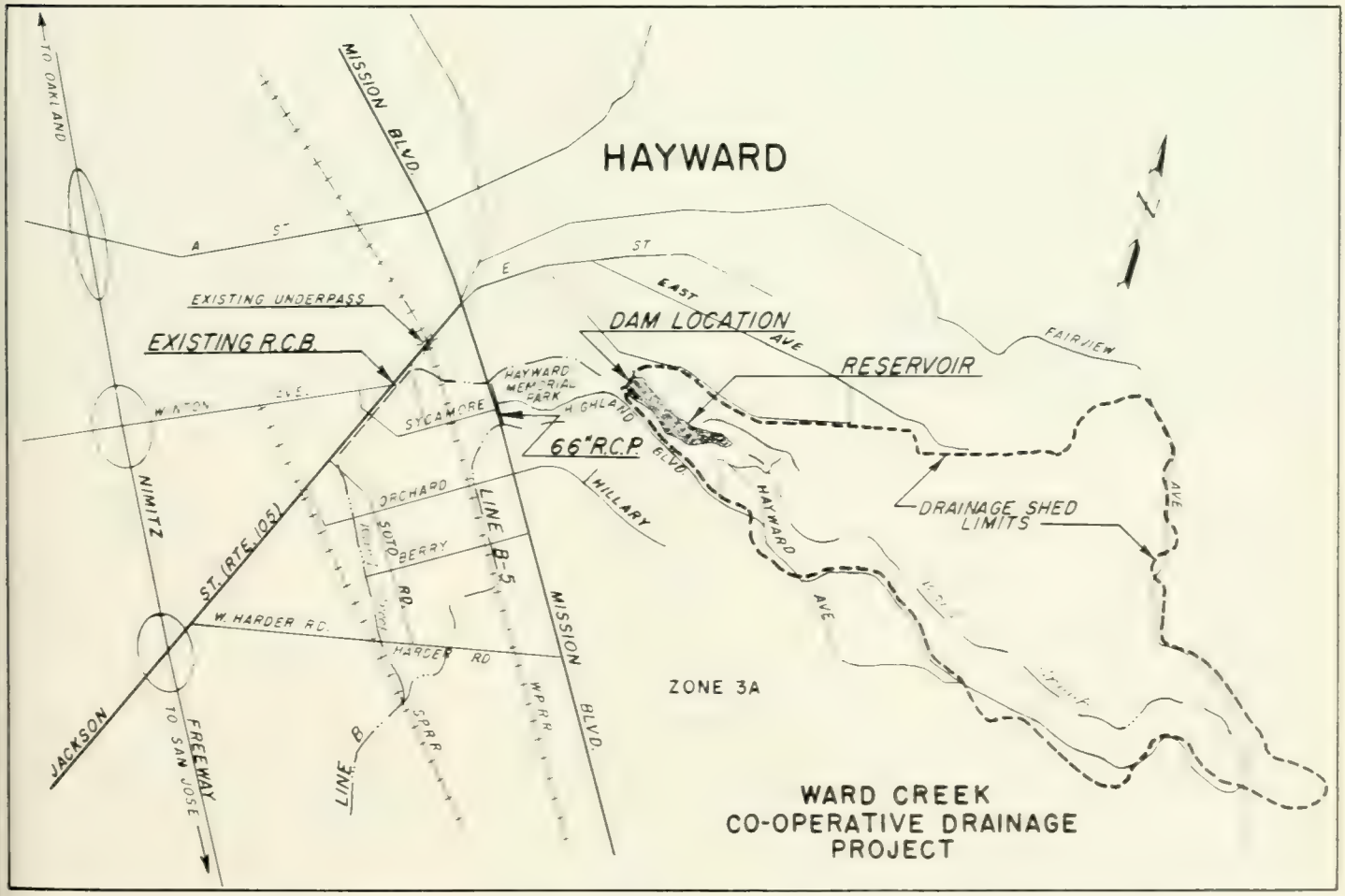
For decades the residential and industrial areas in the Ward Creek Basin in the City of Hayward have been harassed by periodic flooding. For the same length of time, City and County authorities have been besieged with pleas to "do something about it."

> This is a follow-up article to two previous ones concerning District IV drainage problems which appeared in the March-April and May-June, 1961, issues of the magazine.

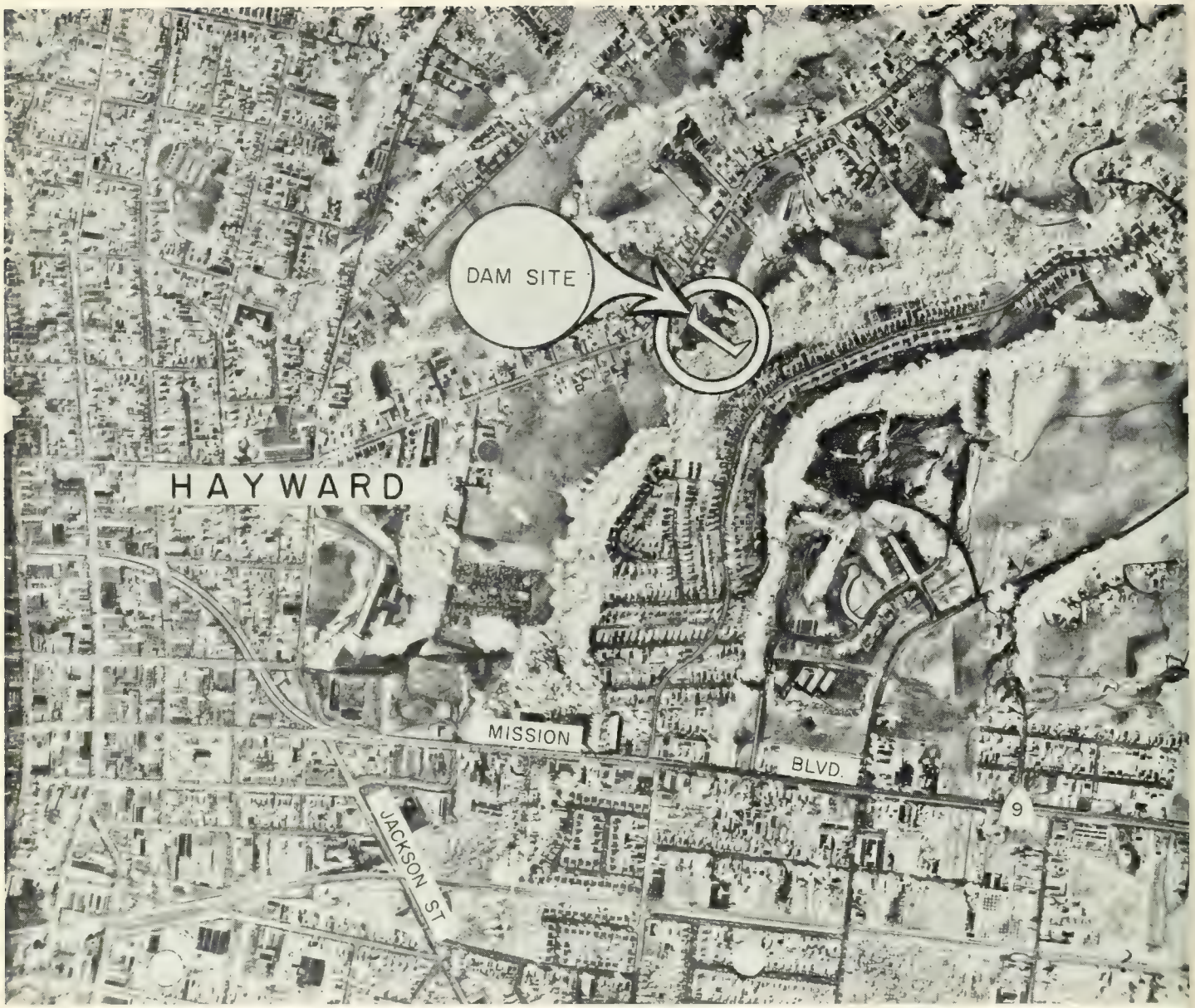
The State Division of Highways inherited a share of this problem when Jackson Street in Hayward was taken over as a portion of State Highway Route 105 and since then has suffered with periodic road closures due to flooding of the Western Pacific Underpass.

Temporary Methods Tried

Various transitory measures have been taken to alleviate the flooding, but mostly they have simply been "suffered with." The aggregate amount of public and private flood damage would be a staggering sum if complete records were available.



A map showing the location of the Ward Creek Dam and reservoir area in the Hayward area. The location of the reinforced concrete box culvert referred to in the article is indicated by "Existing R.C.B." on the map; the recently completed reinforced concrete pipe by "66" R.C.P."



The Ward Creek dam site is indicated by the white circle at the center of this topographic aerial photo of the Hayward area.

In 1956 the Division of Highways commenced design studies on the widening of Jackson Street (State Highway Route 105) between Mission Boulevard and the Nimitz Freeway in the City of Hayward. The proposed plans called for widening the existing highway from a two-lane city street to a four-lane arterial with a 16-foot median strip. The plans also required the construction of two railroad undercrossings on Jackson Street.

During the preliminary drainage studies the local agencies mentioned above were contacted and they expressed interest in co-ordinating drainage studies. The Division of Highways then started drainage studies to determine the most economical means to protect the highway against flooding.

Historical Data

Prior to the development of this area, Ward Creek emerged from the range of hills east of Hayward onto the flat lands and thence to San Francisco Bay. During the development of this area, flood waters were confined to progressively smaller waterways and eventually to a defined channel. A large amount of storage area for flood waters was no longer available. The creek frequently overflowed its banks both in Hayward Memorial Park and along Jackson Street, causing serious flooding damage to public agencies as well as to private property owners.

Ward Creek is now routed along Jackson Street in about 2,300 feet of reinforced concrete box culvert in State right of way from Silva Avenue to Soto Road.

Deficient in Capacity

Among the principal causes of flooding, insofar as concerns Mission Boulevard and Jackson Street, is an inadequate storm drain beginning in Hayward Memorial Park which lies northeasterly of Mission Boulevard. This problem is compounded by poor entrance characteristics and existence

of debris rails in the culvert inlet which plug up even with minor debris conditions. The resulting overflow goes overland to Mission Boulevard and along Mission Boulevard to its intersection with Jackson Street. It then flows along Jackson Street drowning out the existing underpass pumping plant at Western Pacific Railroad. Even with a larger pumping plant, there would be no place to discharge the effluent under present conditions. The underpass could also be flooded by excess flow from the double-box culvert at Silva Avenue and Jackson Street.

Initial Studies

Our initial studies were concerned with enlarging the existing waterway on Jackson Street and providing facilities that would insure collection of flood waters. These facilities would be contained within the present right of way. The estimated cost was staggering and it pointed out that the State could not by itself build a system that would completely eliminate flooding of Jackson Street. This led to exploration of other solutions.

The Flood Control District had once studied a plan to divert the entire flow of Ward Creek from Mission Boulevard southwesterly to the Western Pacific Railroad and then parallel to the railroad to the proposed Line B-5. In that case the existing system on Jackson Street and a proposed supplemental line would have been adequate for the remainder of the runoff. However, it was learned later that subsequent industrial development along the Western Pacific made right of way costs for this plan prohibitive.

A revised plan was outlined by the Flood Control District in 1957 as follows:

1. To utilize the existing facilities on Jackson Street to the limit of their capacity and to increase the capacity of the proposed Line B downstream.
2. To divert the remainder of the runoff southeasterly with a pipe along Mission Boulevard for a distance of about 900′ and thence to Line B-5.
3. To negotiate with the City of Hayward to construct a parallel culvert from the present entrance in the Park to Mission Boulevard so that adequate inlet capacity could be provided. This plan had a number of undesirable features and was also quite expensive.

Final Design Studies

Our final studies demonstrated that an economical and practical solution of the drainage problems on Jackson Street, which are due to the overflow of Ward Creek, lies in a joint effort by the State, the Flood Control District and the City of Hayward. Many consultations and conferences were held concerning this matter from 1958 to 1960.

The general plan was to divert part of Ward Creek flow into Flood Control District proposed Line B-5 with a 66″ reinforced concrete pipe so that the existing system on Jackson Street would be relieved to some extent. But the State felt that these proposals would not adequately protect the new State highway and especially the Western Pacific Underpass.

A satisfactory solution was finally evolved which consisted of the construction of a dam and retention basin in Ward Creek about 3000 feet upstream from Mission Boulevard. Tentative agreement between the State, the Flood Control District and the City of Hayward was reached and preliminary design of the proposed works began in 1958 by the Hydraulics Section of Distrivt IV, Division of Highways.

Final Agreement

The co-operative agreement was finally signed on October 10, 1960. It was agreed that the Flood Control District would construct the flood control dam, retention basin, outlet works and diversion structure along Mission Boulevard, and that the State and Flood Control District would share the cost. The Flood Control District would also prepare plans and specifications, acquire all necessary rights of way, maintain all above facilities and make the necessary secondary agreements with the City of Hayward.

Description of Dam

The rolled earth dam will have a length of 195 feet at the crest and a maximum height of 70 feet. The crest width will be 22 feet and the bottom width of the dam will be approximately 415 feet. Upstream side slope will be 3½:1 and downstream slope 2:1 with a 12-foot berm. The total volume of the dam is estimated to be approximately 60,000 cubic yards. The design of the dam has been approved for safety by the Department of Water Resources.

The primary spillway will consist of a 42-inch concrete pipe beneath the dam with a drop inlet at the inlet end and a stilling basin at the downstream end. It is designed to discharge 250 second-feet at the 100-year condition with a storage volume of 130 acre-feet which would be completely drained after the storm. There will be a freeboard of 9.5 feet for the once in a hundred year storm.

The emergency spillway for the dam will be a concrete control section 40 feet wide at the entrance and narrowing to 20 feet in width 45 feet downstream, with a total length of 228 feet. It will be used for storms in excess of the once in 100-year condition.

Benefits

Tangible benefits to the State are the complete protection against flooding of Jackson Street for the once in 100-year condition and considerable savings over any other solution which could only provide partial protection to the highway.

Tangible benefits to the Flood Control District will be that the Zone 3-A system would be much more effective and require less maintenance expense.

Tangible benefits to the City of Hayward will be a significant reduction in maintenance costs for the various municipal facilities which are subject to frequent inundation.

Other benefits to all three public agencies are the relieving of City residents in the area from chronic flood damages and protection of State Highway users from frequent traffic closures and detours.

Construction of the 66″ reinforced concrete pipe diversion line along Mission Boulevard was completed in September 1961.

The contract for construction of the Ward Creek Dam was awarded in August and the project will be completed late this spring.

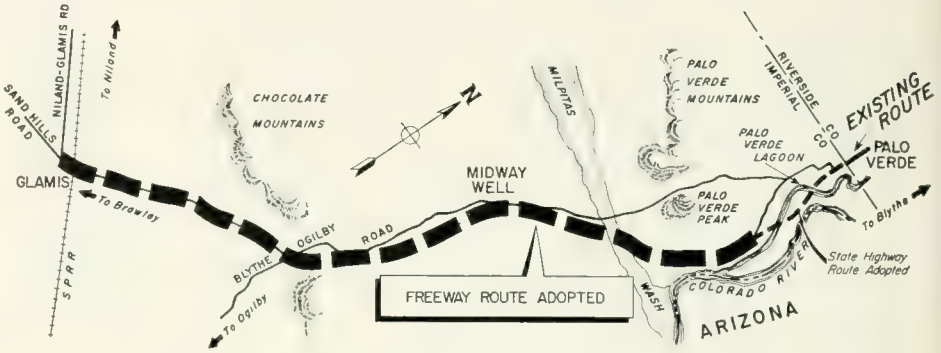
Routes Adopted

Commission's Actions Cover 18 Locations

During the closing months of 1961 the California Highway Commission adopted 13 freeway routes and five routes for conventional highways in various sections of the State.

The Commission also held four public hearings on freeway matters. One hearing, held in the Mammoth Elementary School in Mono County on September 29, concerned the relocation of a portion of US 395 near Crowley Lake. Another hearing, held in King City October 31, involved 19.7 miles of US 101 in Monterey County.

The third public hearing was held in Menlo Park on November 17 concerning a routing for 6.4 miles of State Highway 107 in San Mateo and Santa Clara Counties and the cities of Menlo Park and Palo Alto. The fourth hearing considered freeway routings for sections of Sign Routes 37 and 12 in Sonoma County. It was held in Sonoma on December 12.



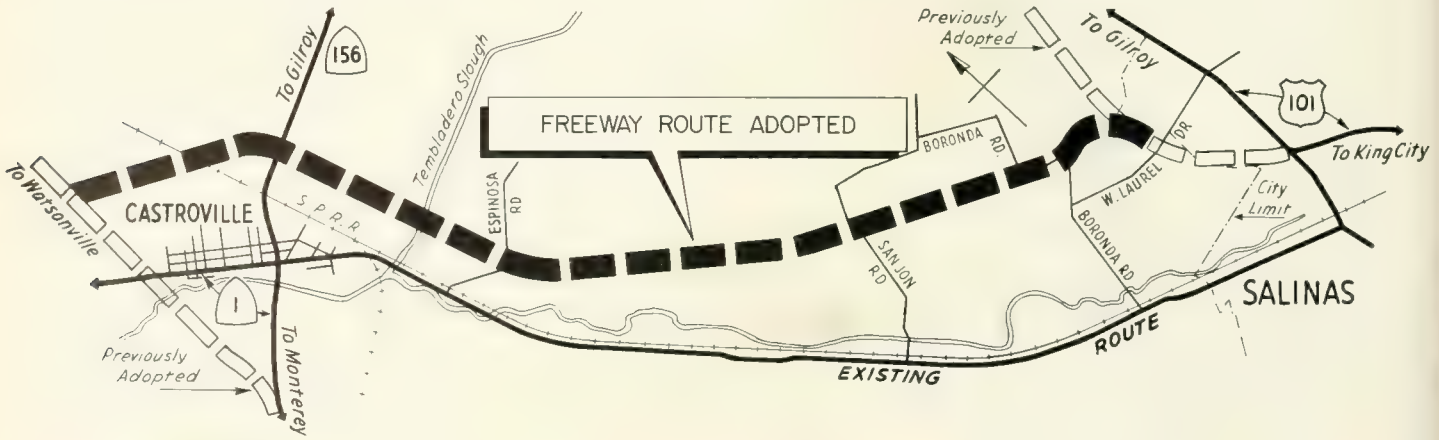


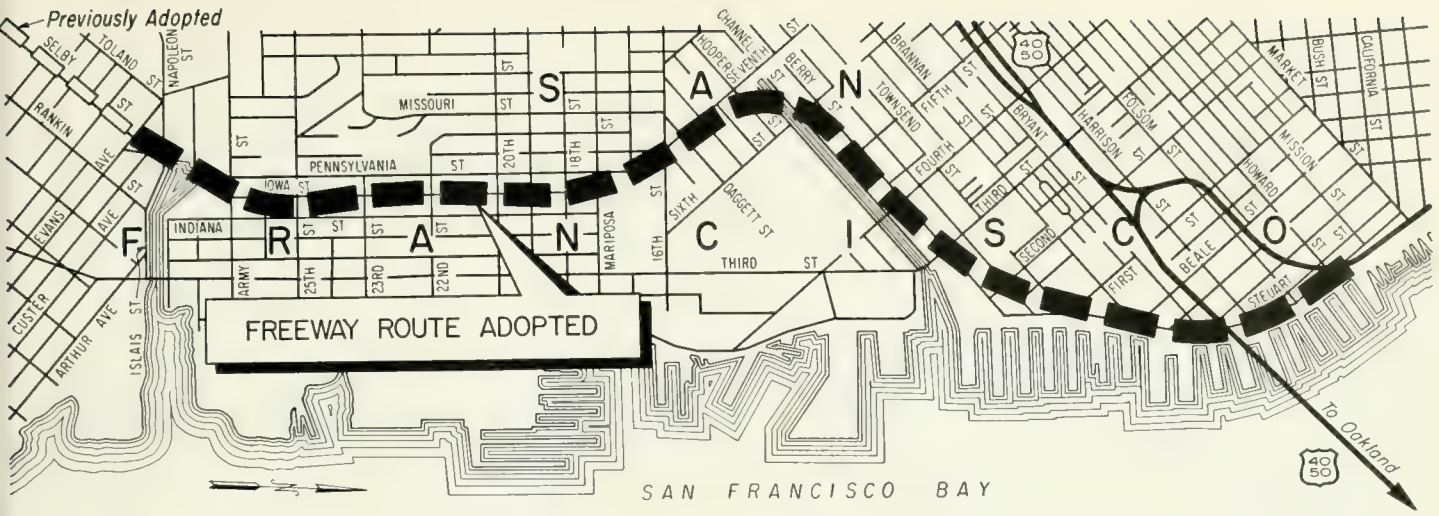
Routes Are Listed

Freeway routes adopted are:

Alpine County—sections of Sign Routes 88 and 88-89 (Carson Pass Highway) which mostly follow the existing highway except that the adopted route for Sign Route 88 runs north of Red Lake while the present road curves around the lake on the south.

Amador County—8.2 miles of Sign Route 104 between the north city limit of Ione and Sign Route 16 just





west of the intersection of Sign Route 49 at Central House.

Humboldt County—two minor revisions of a previously adopted freeway route on US 299. The changes will cut across loops in the previous alignment at Pine Creek and Berry Summit, resulting in shorter distances and greater highway user benefits.

Imperial County—Glamis Road (State Highway Route 146) between Glamis and 5.3 miles south of the Riverside County line and a conventional highway route for the remaining portion of the highway extending to the county line at Palo Verde.

Mariposa and Madera Counties—26.9 miles of State Highway Route 65 in Mariposa and Madera Counties between Mariposa and Oakhurst. Route 65 is an extension southerly of State Sign Route 49, the Mother Lode Highway.

Mendocino County—8.9 miles of Sign Route 128 (Cloverdale to Mendocino Coast Road) between 0.5 mile east of Lazy Creek and Anderson Creek, west of Boonville. The adopted route is on a more direct alignment than the existing highway.

Near Salinas

Monterey County—portion of State Highway Route 117 (Sign Route 68) in and near Salinas and for State Highway Route 118 (Salinas-Castroville Highway) between Castroville and just north of Salinas.

San Bernardino County—32.8 miles of US 66 between Newberry and two miles east of Ludlow. The route runs slightly north of and parallel with the present highway between Newberry and the vicinity of Hector Road and north of and almost contiguous with the existing road between Hector Road and Pisgah Crater Road.

San Diego County—4.2 miles of State Highway Route 280 in San Diego County and the cities of San Diego and National City. The route extends between 0.4 mile east of the adopted route for the San Diego Beltline Freeway (State Highway Route 241) and 0.4 mile east of Sweetwater Road.

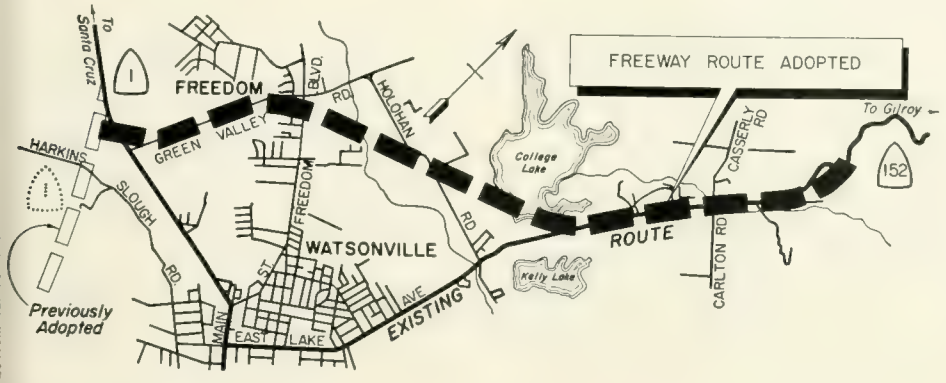
San Francisco City and County—3.4 miles of State Highway Route 253 (Embarcadero Freeway Extension) between Evans Avenue and the Embarcadero Freeway at Howard Street.

Santa Cruz County—route for the relocation of a portion of Sign Route 152 in the vicinity of Watsonville between an adopted freeway route for Sign Route 1 and one mile east of Casserly Road.

Revised Route

Tehama County—revised freeway route for US 99W in Red Bluff between Sacramento Avenue and 0.2 mile south of US 99E. The revised route runs slightly to the west of the previously adopted route, crosses the existing highway (US 99W) at Kimball Road and continues northerly to rejoin the previously adopted route just south of US 99E.

Tuolumne County—revised freeway route for 3.9 miles of Sign Route 120 (Big Oak Flat Road) between one mile east of Hardin Flat and one mile west of Carl Inn near the Yosemite National Park Boundary. The revised route places the highway to the south of rather than to the north of the South Fork of the Tuolumne River west of Ackerson Creek and closer to the existing highway. The change will reflect savings in construction costs with no reduction in traffic service.



MAINTENANCE ENGINEERS MEET IN SACRAMENTO



The first Operations-Maintenance Engineers' Meeting was held in Sacramento on November 8 and 9, 1961. This two-day meeting covered such subjects as new classifications for maintenance field personnel; new accounting methods as they obtain to maintenance operations; discussion on equipment and its use in maintenance work; problems in connection with Service and Supply regarding materials used by the Maintenance Department and other miscellaneous items. Those participating were District Maintenance Engineers, unless otherwise identified. Seated at table clockwise: R. J. Ivy, Supervising Bridge Engineer (Maintenance); L. E. Elder, District V; R. D. Kinsey, Assistant District Engineer (Maintenance) District IV; R. I. Nicholson, District III; R. J. Wilson, District II; C. G. Ure, District I; Scott Lathrop, Principal Highway Engineer, Public Information and Personnel, Sacramento; L. R. Gillis, Assistant State Highway Engineer (Operations), Sacramento; F. E. Baxter, Maintenance Engineer, Sacramento; J. P. Murphy, Deputy State Highway Engineer; J. C. Womack, State Highway Engineer; H. B. Whitnall, District XI; E. Thomas, District X; M. E. Fischer, District IX; R. H. Ramey, District VIII; F. B. Correa, Assistant District Engineer (Maintenance), District VII; T. J. Dunn, Supervising Bridge Engineer (Maintenance Bay Bridge); R. A. Qualls, District VI. Seated around room clockwise; Jack Trentham, Personnel Analyst, Sacramento; Dorothy Dixon, Personnel Analyst, Sacramento; Marian Smith, Personnel Officer, Sacramento; Lyman Olsen, Assistant Maintenance Engineer, Sacramento; Byron Borup, Assistant Maintenance Engineer, Sacramento; W. Z. Hegy, Assistant District Engineer, District I; W. M. Nett, Assistant District Engineer, District II; E. L. Miller, Assistant District Engineer, District III; L. A. Weymouth, District Engineer, District IV. Standing rear clockwise: R. B. Luckenbach, Assistant District Engineer, District XI; C. A. Shervington, District Engineer, District IX; E. L. Tinney, Assistant District Engineer, District X, Fred Everitt, Service and Supply Engineer, Sacramento; A. L. Himelhoch, District Engineer, District VII; Geo. Wofford, Assistant District Engineer, District V, E. G. Bower, Assistant District Engineer, District VIII; Frank Roush, Assistant District Engineer, District VI.

Construction Costs Show Fourth Quarter Rise

The California Highway Construction Cost Index for the fourth quarter of 1961 stands at 238.5, an increase of 8.0 index points or 3.5 percent over the third quarter.

The index for the year 1961 has been computed at 239.1, 6.6 index points or 2.8 percent higher than the figure for the year 1960.

The number of bidders per project during the fourth quarter increased from 5.0 to 6.5.

The small fluctuations during the past several years, particularly in the yearly index figures, point toward a trend of stabilization in highway costs.

A similar trend is indicated by the Bureau of Public Roads Composite Mile Index, based on Federal-Aid highway construction contracts awarded by state highway departments. The third quarter index for 1961, the latest available, decreases 2.5 points or 1.1 percent. This index also has shown only small fluctuations.

The Engineering News - Record Construction Cost Index for the fourth quarter of 1961 remained practically unchanged at 353.3, an increase of 0.4 points or 0.1 percent over the previous quarter. This figure will be subject to adjustment due to retroactive wage increases.

Vehicle Registration Passes Nine Million

Year-end vehicle registration figures for 1961 show the traditional increase to a new high total, and are especially noteworthy in exceeding 9 million. A tabulation of totals registered on payment of fees, by counties, together with a statewide total of exempt public service and government vehicles, indicates a grand total of 9,007,869. The fee-paid vehicles number 8,889,860, of which the Los Angeles County total is 3,404,147, or 38.3 percent. The new total is in accord with the estimate of the Department of Motor Vehicles for the calendar year 1961.



Maintenance crew repairing section of Bayshore Freeway in vicinity of San Mateo. A few decades ago this would have been pick and shovel job for a dozen men and several horses. Mobile aircompressor simplifies task it so can be quickly done by a few men.

NEW MAINTENANCE MAN CLASSES

The first major change to come out of the recent comprehensive survey of the Division of Highways personnel neeeds is the establishment of the new series of classification for maintenance man. This change not only clarifies the status of the maintenance man, but also recognizes the changing skill requirements in this field.

Three New Classes

Three new classes have been approved by the State Personnel Board —maintenance man I, II, and III. Highway equipment operator-laborer and highway leadingman classifications are discontinued, replaced by maintenance man II, and III, respectively. Promotion from these classifications will, as with the previous classifications, be through the classes of highway foreman, senior highway foreman, and highway superintendent.

The classification maintenance man I is to distinguish from laborer by a one-step wage differential. The laborer classification is retained, but only for assignments in other than the maintenance department, such as the equipment and materials and research departments.

New Examinations

New examinations for maintenance man I and II are now or will soon be in preparation. In the meantime, instructions have been issued from headquarters directing changes of the laborers in the maintenance department to maintenance man I where qualified. Men promoted must be working in maintenance functions, and must be licensed to operate two-axle, single-motor vehicles with one towed vehicle.

More Emphasis on Mechanization

Specifications have been prepared for the three grades of the new classification, and although the duties will be somewhat the same as for the previous classification, more emphasis is placed on knowledge of good maintenance practice and operation of equipment. These requisite knowledges and abilities will naturally become more complex as the employee advances through the grades. The emphasis is placed on developing skilled personnel for work in an increasingly mechanized field.

The II grade will be expected to have more knowledge of this field, better understanding of the upkeep and operation of a wider variety of equipment. The III grade must have advanced even farther in these abilities and skills, and in addition, will be expected to do some supervisory work. All grades will be required to have appropriate driver's licenses.

Detailed instructions on this personnel change are given in a Division of Highways circular letter.

Vietnam Highways

A California Engineer Goes to Southeast Asia

By GEORGE E. GRAY, Associate Highway Engineer

In the late summer of 1958, while working in District VIII, I became interested in a major highway improvement and rehabilitation program which was under way in the fledging Southeast Asia nation of South Vietnam and accepted a two-year contract as chief highway design engineer on the project.

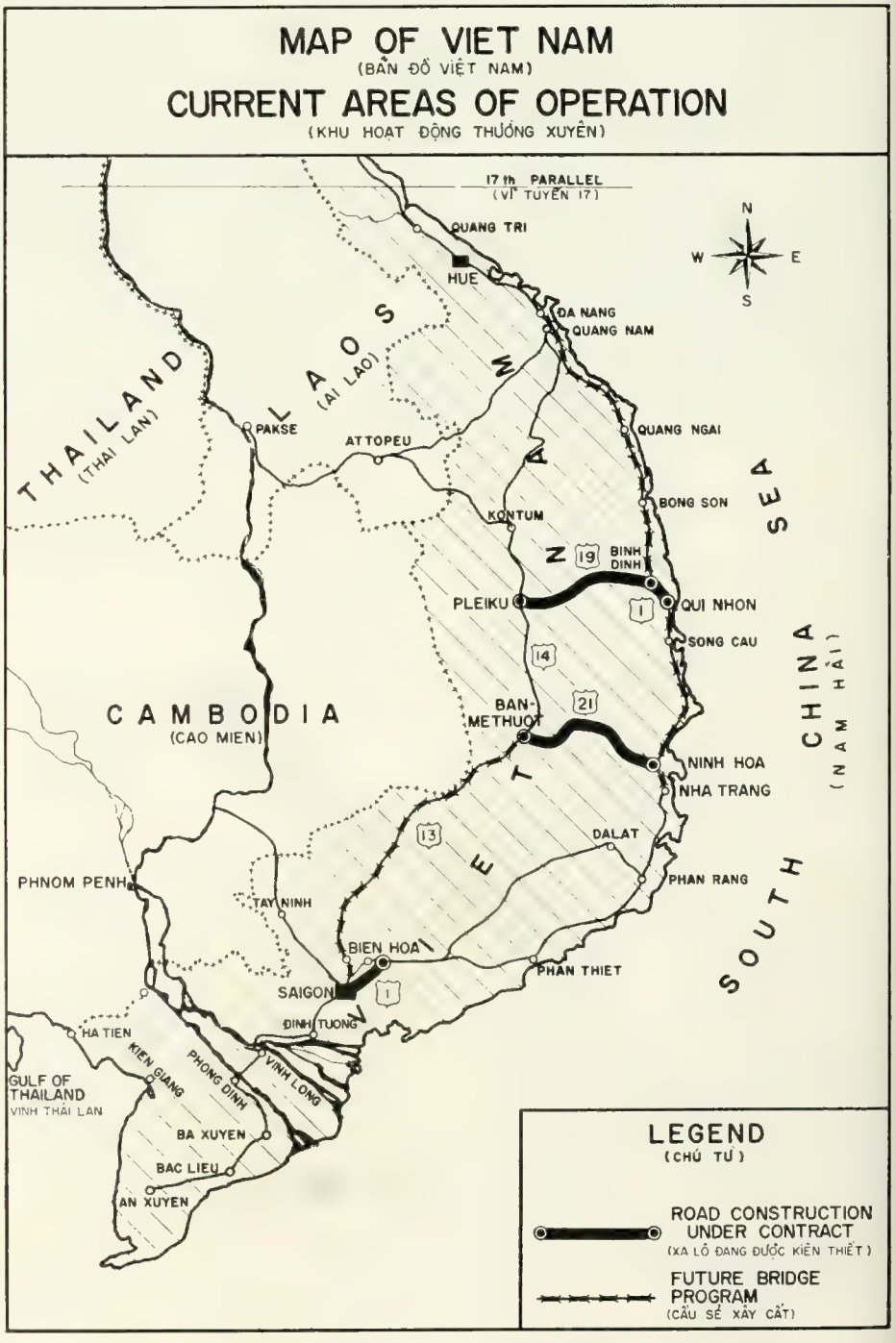
Although the program was sponsored by the International Co-operation Administration, my employer, Capitol Engineering Corporation of Dillsburg, Pennsylvania, was working under the authority of a contract with the government of Vietnam.

The construction contractor was Johnson, Drake and Piper, Inc., of Vietnam.

In essence the engineering contractor, Capitol, was to perform all the services of a typical State Highway Department except for maintenance. This latter function, along with all construction responsibility, including the manufacturing of many basic items such as reinforced concrete pipe, was undertaken by the construction firm. Both companies maintained extensive programs of on-the-job training with the aim of leaving a cadre of trained technicians at the end of the project. Their success is illustrated by the fact that as the program proceeded, more and more of the tasks were taken over by trained Vietnamese.

A New Nation

South Vietnam became a new nation as a result of the Geneva Accord of 1954. It encompasses the southeastern portion of what was commonly called French Indochina prior to World War II. To the north it is separated from Communist dominated North Vietnam by the 17th parallel. It is a nation of 12,000,000 people. During World War II, when Japan occupied the area, and during the Indochina war, from 1945 to 1954, the highway system of Vietnam not only was systematically damaged by bombing and sabotage but any maintenance work was difficult and new construction almost impossible. By July 1954, when semipeace came to the country, highway travel had practically ceased. Many of the existing bridges were narrow military structures and often



it was necessary to ford streams or to use makeshift rafts.

New construction undertaken by the Vietnamese was based on antiquated design and construction precepts, with narrow pavements and high grass-covered shoulders the rule.

The I.C.A. sponsored highway program was initiated as part of an overall aid plan directed towards helping the new nation become economically and militarily strong enough to determine its own future.

Active construction work was concentrated in the following areas:

(1) A section of Highway No. 1 between the capital city of Saigon and a major manufacturing center, Bien Hoa, approximately 32 kilometers (20 miles) north.

(2) A 100-mile section of National Route 21 between the tea-coffee-rubber center of Ban Me Thuot and the junction with National Route 1 at Ninh Hoa.

(3) A section of National Route 19 between the mountain center of Pleiku and the junction with National Route 1 at Binh Dinh and a connecting link to the seaport of Quinhon, totaling 112 miles.

Metric System Used

Design plans were based on the metric system and were similar in concept and presentation to the regular State of California plans. Design speeds used varied considerably with the terrain. One hundred k.p.h. (62 m.p.h.) was used on the Saigon-Bien-Hoa project and, wherever practical, on the northern construction. A design speed as low as 15 m.p.h. with 9 percent grades was necessary in a few mountainous locations on the northern projects.



Antiquated construction methods are still being used in some sections of Viet Nam.

The structural section was based on various soils information and data with a modified LBR test furnishing the dominant design criteria. Surfacing varied from 3-inch of A.C. on the Saigon-Bien-Hoa portion to a penetration type treatment on the rural routes.

Drainage design was considerably handicapped because of lack of information on rainfall and runoff. Several severe monsoon-type storms during construction served to point out deficiencies, the hard way, and the finished facilities are expected to function with no head for the yearly storm and with head for a 10-year storm. Bridge design was based on passing a 25-year storm with adequate freeboard (usually 2 feet) to allow for floating debris—at least that is the intent.



A section of new divided highway near Saigon showing an off ramp. Note the water buffalo cart going down the drainage ditch.

Settlement Problem

Construction across some of the rice paddy areas caused considerable trouble. Up to two meters (6 feet 6 inches) of surcharge with up to two years of settlement failed to consolidate the underlying marine clays in some locations. Due to the necessity of completing the highway as soon as practical, the grade was set to allow for additional settlement and the highway completed. Sand drains were not deemed practical because of the expense and the slow rate of water transfer in the fine clay.

Some slide and slipout failures occurred during construction with the major trouble occurring in the placing of the bridge approach fills in the paddy land areas. Usually flattening the fill slopes was adequate to eliminate the problem with construction of counterweight fills and berms necessary in a few isolated instances.

Most bridges on the rural routes were of 24-inch steel beam construction with some concrete "T" beams and some flatslabs also included. The two major bridges on the Saigon-Bien-Hoa route have continuous plate girders for the main spans and with the approach spans total 3,250 feet and 1,500 feet in length. The main piers for the shorter of these two structures are based on the drilled-in caisson principle similar to that being used on the Benicia-Martinez Bridge. A complete description of this system is given in the March 1961 issue of *Civil Engineering*.

Talking About Highways — *Comments from Here and There*

Misses Old Route—But Not Much

City Editor Dick Revenaugh of the *Sacramento Union* wrote a feature calling attention to the difference between his former daily commute route on local streets and roads and the newly opened South Sacramento Freeway. He noted some things he would miss on the old route such as: ("These are the things I'll miss—but not much!")

(1) The "swing and sway of the family clunker" rounding curves.

(2) Slow driving through residential areas "so that you can get the full effect when one neighborhood tousle-head clouts another."

(3) The opportunity to "check the patronage" at a local shopping center.

(4) The "menu" at a local soup factory.

(5) Darting boulevard traffic "which set a man up for a day of combat."

"I'll miss these things," he wrote, "because today I'm modern. I put the old car in the right lane a block from my house, turned on the gas, and in 15 minutes I was walking in the front door of the office—a half hour early.

"Me and my old sedan, we're grateful. In the 15 minutes we didn't use the brakes until we got to U Street in Sacramento. We didn't dodge a single truck trying to make an impossible turn on a narrow street. We didn't worry about pedestrians or half-brained little kids chasing a ball.

"We drove the new South Sacramento Freeway for the first time and have come to realize how it feels to be a 10-minute commuter. . . .

"And probably best of all, the sedan and I, we're not going to part company as soon as we thought. I think it's going to last for 130,000 miles instead of crumbling like a one-hoss shay tomorrow.

"As I said, we're grateful and we'll bet 75,000 other southbound commuters are too."

Gripe About the Shadows

Gene Blake of the *Los Angeles Times* introduced an article on freeway route selection this way:

"Just let the word get out that a freeway is being planned for a certain community—and you never saw so many 'experts' on exactly where it should be routed.

"All of them can give many good reasons why it should be built along a route which—coincidentally, of course—will not remove or be too close to their own homes or businesses.

Some who have thoroughly enjoyed using a freeway to get somewhere else are suddenly horrified at the thought of any going through their community at all. . . .

"'Twas ever thus, wherever freeways have gone through built-up, populated areas. Not everyone can be pleased.

"Former Pasadena Mayor Ray Woods put it well when he said, 'Even if they hung freeways from skyhooks, somebody would gripe about the shadows'."

Excellent Road Administration In Cities and Counties

From a speech by State Senator Randolph Collier before a meeting of the California State Chamber of Commerce in Los Angeles:

"The ultimate success of the 1947 Highway Act demonstrated the point I wish to make. Actually, it was the beginning and not the end-point of our efforts. As a revenue-producing measure it fell far short of our real needs, but it did many other things important to highway administration in California. As one example, it provided for the improvement of county road management by insisting upon consolidation of districts and qualification of road commissioners. As one of its most important features, it established the total responsibility of the State for the construction and maintenance of State highways *in cities*—an action which made California unique among the states and led to the development of our great metropolitan freeway systems.

"Following 1947 we had to bring life to the words of law. We concentrated with some vigor on certain counties. . . . And we got results! Probably one of the least appreciated facts about California's total highway program is the current excellence of its local road and street administrations."

Freeways Add to Property Values

"Property owners in a corridor where freeway construction is planned want to know how the new facility will affect the value of their holdings. Public officials and civic leaders are concerned because expressway development will take many square feet off the tax rolls.

"This matter has been studied in many parts of the country. In summary, these investigations show that freeways generally increase the value of adjacent property, whether undeveloped land or improved commerical, residential or industrial property.

"Some specific examples: In Houston, during a five-year period, land values along the Gulf Freeway increased 65 percent more in dollar value than land distant from the facility. A study by Texas A & M College of the Central Expressway in Dallas described the increase in tax valuation on abutting property as 'astounding'—the gain being on the order of 544 percent from 1941 to 1955. Communities along the route of Boston's circumferential freeway report property value increases as high as 700 percent. In Atlanta, undeveloped land rose from $100-$400 per acre to $1,200-$1,400 per acre after the freeway was built. Along the Eastshore Freeway in California, average raw land values increased from $500 to $21,000 on the average."—From *METRO*, a booklet on urban traffic problems published by the American Automobile Association.

CABLE MOVING

Continued from page 44 . .

contained 5,400 pairs of wires. These cables carry telephone, telegraph, teletype, radio and television communications, and many hundreds of special and important voice and communication circuits that require continuous communication service.

Two Plans Submitted

After extensive preliminary studies of this relocation problem by the P.T. and T. and the State Division of Highways, two methods for relocating these communication facilities were offered.

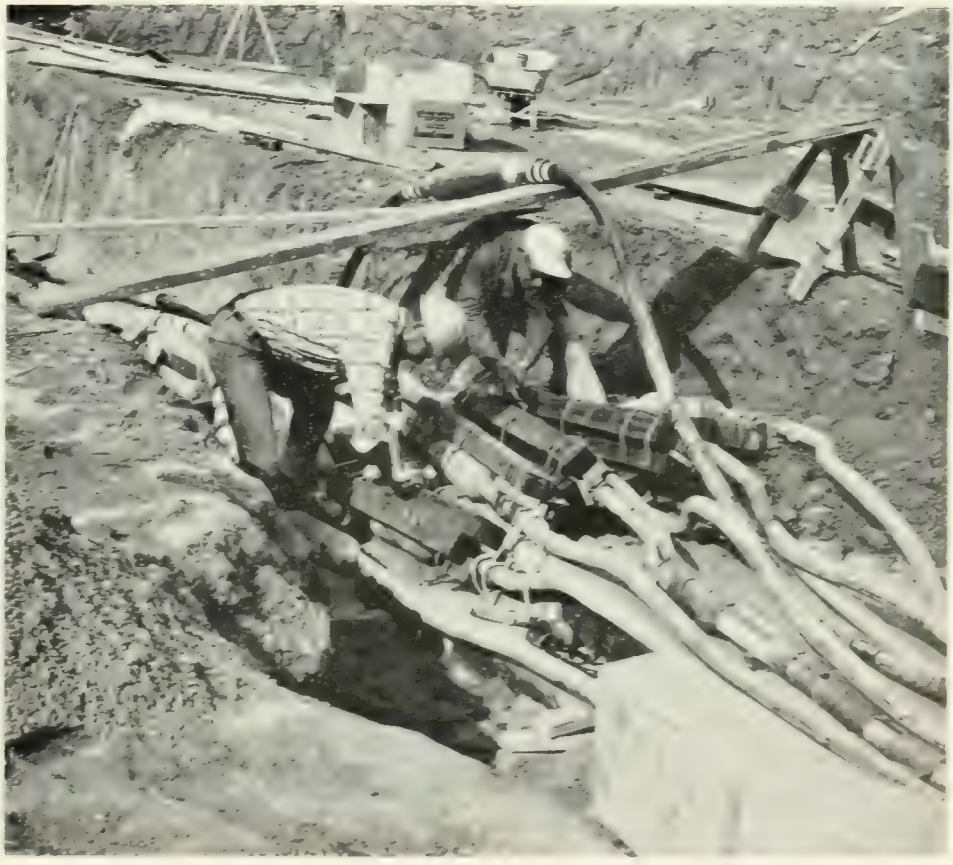
The first and most common plan would require the rerouting of the Kelso and Olive Streets cables crossing the freeway right-of-way to a new location in the Manchester Boulevard overcrossing structure. This could be accomplished by installing ducts and cables in Ash Street, in Manchester Boulevard, and in La Cienega Boulevard from Kelso Street east of Ash Street to Olive Street west of La Cienega Boulevard. In addition to the installation of many hundreds of feet of underground ducts and cable, this plan would require the splicing of many thousands of wisre.

Cable splicing is a time-consuming operation even under normal conditions. Because of the urgency of the communications transmitted over these wires around the clock, the splicing of the conductors of these cables would be slower than usual since it would have to be done during the short periods of time that the circuits were not being used. This would make it necessary for telephone company personnel to work around the clock to maintain continuous service over these facilities.

The second plan involved the construction of a utility bridge across the freeway right-of-way at Olive Street and the installation of new duct and cable in Ash Street, from Kelso Street to Olive Street, and in La Cienega Boulevard from the utility bridge to Olive Street. This plan would allow all cables in Olive Street to be transferred intact to the utility bridge



Breaking and removing multiple tile telephone duct to expose cables



Timbers are lashed to the telephone cable spliced for protection



Transferring telephone cables to the new utility overcrossing bridge.

without splicing. Cables from the Kelso Street system would have to be spliced in two manholes. This plan was adopted because of the substantial savings in money and time that would be realized by not routing the cables through the Manchester Boulevard overcrossing.

Savings Realized

The preliminary estimate of cost and time required for the relocation through the Manchester Boulevard overcrossing under the first plan was $200,000 and eight months' time. The preliminary estimate for relocating the cable by use of a separate utility bridge under the second plan amounted to a cost of $80,000 and four months' total relocation time.

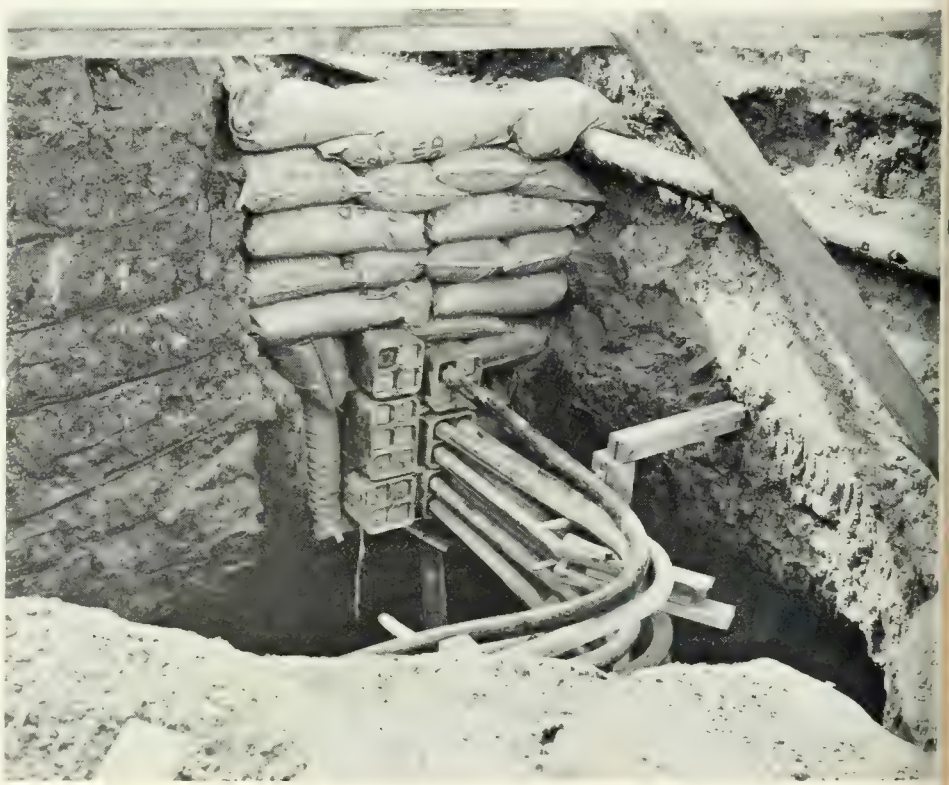
Based on the assumption the $200,000 estimate for relocating the utility facilities through the Manchester Boulevard overcrossing was essentially accurate, and using the actual utility relocation cost, the total savings amounted to $146,000. In addition, the relocation plan used saved approximately four months of utility relocation time. Of significant interest is the fact that the duct and cable installation in the utility bridge was completed in 24 working days, or less than half the 50 days' time estimated.

Utility Bridge Construction

The Olive Street utility bridge was built about 40 feet south of the Telephone Company duct and cable system then existing in the north side of Olive Street. This location was selected to avoid interference with the construction of the proposed northbound on ramp from Manchester Boulevard.

A trench about 9 feet wide and 5 feet deep was excavated across the freeway right-of-way from west of Ash Street to east of La Cienega Boulevard. This provided for the construction of the bridge superstructure at about existing city street grade, since the freeway at this location will be in cut. Two holes 16 inches in diameter were drilled from the bottom of this trench to the freeway subgrade at the exact location of each of the two abutments and five bents. Type 14BP73 "H" bearing steel piles were placed in the holes and driven to the required 55-ton bearing. This avoided the necessity of extensive excavation in order to construct the substructure and enabled the construction of the superstructure to proceed at original ground level.

At a later date when the freeway prism is excavated, the exposed piles will be encased in concrete to complete the construction of the bridge bents.



Telephone cables in position at the manhole location.

Structurally, the overcrossing is a 6-span continuous reinforced concrete "U" section about 397 feet long with an overall dimension of 5 feet 4 inches wide and 3 feet 6 inches deep, and 2 feet 6 inches wide with a 2-foot 10-inch deep cavity. The "U" is closed at the top with 3 x 5 foot galvanized steel plates bolted to angles imbedded in the top of the girder stems. The superstructure is supported at the bents on rigid concrete caps on the bearing piles, and at the abutments on unattached concrete caps. Sliding joints composed of asbestos sheet packing are provided at the abutments to take care of the expansion and contraction movements of the superstructure.

Duct Installation

After completion of the utility bridge, the Telephone Company contractor installed 24 multiple tile ducts in the bottom of the bridge cell and in the bridge approaches, and connecting to the proposed manholes in Ash Street and La Cienega Boulevard. Lightweight concrete was poured around and over these ducts in the bridge to secure them in place. The top of the concrete was leveled and smoothed about 10 inches below the top of the bridge to provide a suitable surface for the installation of the cables.

The earth was carefully removed from around the existing ducts in the north side of Olive Street, and the ground between these ducts and the bridge was graded from below the then existing duct system to the top of the bridge to provide working space for the moving of the cables. Sheets of polyethylene were placed over the north side of the structure before any earth was filled in the trench to protect the bridge concrete from being discovered.

Cables Transferred

The old multiple tile ducts in the north side of Olive Street, between Ash Street and La Cienega Boulevard and the manhole east of La Cienega Boulevard were carefully broken to expose the cables and cable splices. The first operation was to protect the cable splices, the most vulnerable part of the cable system. Each of the cable splices was lashed to rigid timbers to protect it during moving operations. As each cable in the duct was exposed, it was raised and tied to timbers for protection and ease of handling.



Telephone cables relocated in the new utility overcrossing bridge.

When all preparations were completed, a crane was positioned to raise and move the cable splices and protecting timbers, and men were stationed at intervals along the length of the cable. Acting as a unit, the men and the crane raised each cable in turn and moved it into the bridge cavity over the multiple tile duct. The cables were placed in split tile in the bridge approaches, extending to the location of the proposed manholes at Ash Street and at La Cienega Boulevard. Since the length of the new duct system in the bridge was exactly the same as the old route, there was no need to lengthen or shorten the cables and, therefore, no cable splicing was required. After all the cables were in place, new manholes were built at the ends of the ducts across the freeway at Ash Street and La Cienega Boulevard.

It is interesting to note that in a one-foot length of all of the cables in the bridge, there are over 33,000 feet or 6½ miles of wire.

Method Is Novel

Although the construction of utility bridges is not an innovation, the method of transferring cables intact to the bridge structure was novel. This method of relocation should be considered for telephone cables containing many conductors and/or having important services that require continuous operation, or when the temporary rearrangement of utility facilities involves extensive and costly detours.

The District VII Right-of-Way Clearance Department staff wishes to acknowledge the co-operation of The Pacific Telephone and Telegraph Company representatives for their contribution in the successful development of this new "Transfer Intact Method" for the relocation of important telephone communication cables. Special appreciation is extended to Gene B. Graham of the Los Angeles office of the P. T. and T. for first suggesting this new method and for his assistance in this project.

Index of California Highways and Public Works

January to December 1961

SUBJECT INDEX

	Issue	Page
Accounting Modernizes	May - June	54
Accounting Personnel Study New Data System	Jul. - Aug.	63
AASHO Test Ends, Data Being Compiled	Jan. - Feb.	47
Archaeology—State Agencies Cooperate to Save Midden Sites	May - June	45
Arroyo Seco—Pasadena Freeway Has 20th Birthday	Jan. - Feb.	57
Asbill, J. M., Promoted to R.W Agent	Mar. - Apr.	23
Asphalt Test Ten Different Road Samples Show Varying Durability	May - June	59
ACR No. 132 Relative to planting and landscaping) state highways	Mar. - Apr.	41
Akum Road—El Dorado County Completes Difficult Route Relocation	Mar. - Apr.	27
Automation		
Automatic Counters Save $300,000 Yearly	Mar. - Apr.	74
Accounting Modernizes	May - June	54
Highways Accounting Personnel Study New Data System	Jul. - Aug.	63
Awards		
Golden Beaver Award, G. T. McCoy Receives	Jan. - Feb.	75
Median Barrier Tests Win National Honors	Jan. - Feb.	74
Philadelphia Exhibit, Lab Photo Wins Prize at	Mar. - Apr.	72
Twenty-five-year Awards	Jan. - Feb.	72
	Mar. - Apr.	72
	May - June	51
	Jul. - Aug.	71
	Sept. - Oct.	24
Bank Protection, Div. Publishes New Reference Book	Jul. - Aug.	70
Barrier (Median) Tests Win National Honors	Jan. - Feb.	74
Photo of Crash Test Wins Prize	Mar. - Apr.	72
Barrier Report—Performance of Beam, Cable Types Analyzed	Sept. -Oct.	18
Base (Cement Treated)—Improved Spreading Devices, Control Methods Speed Work	Jan. -Feb.	49
Benicia-Martinez Bridge Job Completion Scheduled for Summer of 1962	Jul. - Aug.	18
Better Highways Information Foundation	Mar. - Apr.	77
Bond Issue—Final Payment Made on State's 1909 Road Bonds	Jul. - Aug.	61
Bonners Stag Dent Annual	May - June	78
Bradford Heads New Transport Agency	Sept - Oct.	1
Bridge Dept. Conducts Own Correspondence Lessons -Design Course.	Jan. - Feb.	69
Bridges		
San Diego—Four-level Interchange.	Mar - Apr.	61
San Lorenzo Creek—Cable Relocation	Jan. - Feb.	64
Scotia Bridge—Parallel 2-lane Structure	Mar. - Apr.	24
Stockton, Harding Way Underpass.	Jan. - Feb.	66
Terminal Island Bridge named "Vincent Thomas Bridge"	Jul. - Aug.	33
British Research Head Visits Lab.	Sept - Oct.	69
Building, Public Inspects New SBd Highway	Sept. - Oct.	73
California Highway Commission		Inside
50th Anniversary	Jul. - Aug.	back cover
Kofman Succeeds Judge Purchio		
California Highways and Public Works		
The Reader Survey	Jul. - Aug.	65
California Roadsides—1	Jan. - Feb.	2
2	Mar - Apr.	46
3	May - June	65
4	Jul. - Aug.	34
California Toll Bridge Authority		
James Thacher Named to	Mar - Apr.	34
Terminal Island Bridge Bonds Sold.	May - June	79
Toll Bridge Project Expanded (SM-Hayward Br.	Sept. - Oct.	Inside front cover
Canadians Study Right of Way Procedure	May - June	22
Carson Spur—Public's Patience Eases Job of Widening on Highway 88	Jan. - Feb.	11
C.T.B.—Improved Spreading Devices, Control Methods Speed Work	Jan. - Feb.	49
Central Letter New Management Section Streamlines Procedures	Mar. - Apr.	78
Corona Bypass—Riverside Freeway Now Continuous for 24 Miles	Jul. - Aug.	27
Cost Index—Highways		
4th Qtr. 1960	Mar. - Apr.	29
1st Qtr. 1961	May - June	30
2d Qtr. 1961	Jul. - Aug.	63
Cost Ind. Bridge	Mar. - Apr.	73
Culvert Life—New Test Methods Estimate Life Expectancy of Pipe	Jan. - Feb.	48
Culverts—Hydraulic Model, Energy Dissipator Tested in L.A. Laboratory	Jul. - Aug.	67
Dams		
Nicasio Reservoir	Jul. - Aug.	49
Whiskeytown Dam	May - June	52
Design Course—Bridge Dept.	Jan. - Feb.	69
Drainage		
Flood Problems—State, Local Agencies Co-operate in Improving Highway Drainage	Mar. - Apr.	56
Driver Reaction Tested by Simulator Device	Mar. - Apr.	79
Driving Training—Departmentl Program Covers Testing of 13,300 Employees	Mar - Apr	64
Economic Studies		
Farmlands—Freeway Construction Requires Few Adjustments (Winter Madison	May - June	38
Remainder Parcels — Co-operative State-B.P.R. Appraisal Study Underway	Jan. Feb.	38
Rural Fringe—Freeway Speeds Increase in Land Use, Land Value (Roseville Fwy)	Mar. Apr.	30
Embarcadero Freeway — Temporary Sightseeing Area Installed	Mar. Apr.	2
Equipment		
C.T.B.—Improved Spreading Devices	Jan. - Feb.	49
Paver Control—Experimental Device Used in Resurfacing Operation	Mar. - Apr.	48
Traffic Striper—New Machine Now in Service Has Flexibility and Ease of Control	Jul. - Aug.	31
Erreca, John—Appointed to C.H.C.	Jan. - Feb.	37
Exhibits		
Freeway, at Pasadena Diamond Jubilee	Jul. - Aug.	66
Highways State Fair	Sept. - Oct.	72
Farmlands—Freeway Construction Requires Few Adjustments, Study Shows	May - June	38
Federal-aid Highway Contracts Total $2,038 in Land	May - June	22
Fill, Marsh Area—Sand Drains Aid in Soil Stabilization	Sept. - Oct.	74
Flood Problems—State, Local Agencies Co-operate in Improving Highway Drainage	Mar. - Apr.	56
State Helps on Guadalupe, Walnut Creek Projects	May - June	74
Foley, E. R., Transferred from Dist. IX to V	May - June	31
Four-level Structure (San Diego)	Mar. - Apr.	61
Freeway Interchange (No. Sac-Elvas) Is Subject of Study	Jul. - Aug.	44
Funds		
Bond Issue—Final Payment Made on State's 1909 Road Bonds	Jul. - Aug.	61
Legislation Includes New Highway Fund Formula	Sept. - Oct.	72
Geer Road—New F.A.S. Bridge Cuts Travel Distance 4½ Miles	May - June	67
Guadalupe River Co-operative Drainage Project	May - June	74
Guthrie, James V., Reappointed	Jan. - Feb.	37
Awarded degree of Doctor of Humane Letters	Jul. - Aug.	30
Harding Way—Traffic Flow in Stockton Aided by New Underpass	Jan. - Feb.	66
Hess, Rudolph, Succeeds Balfour	Jan. - Feb.	48
Highway Research Board award on "Dynamic Full Scale Tests of Median Barrier" paper	Jan. - Feb.	74
Highway Transportation Agency (Bradford appointed head of)	Sept. - Oct.	1
Hydraulic Model—Energy Dissipator Tested in L.A. Laboratory	Jul. - Aug.	67
Highway Projects by Counties		
Alameda County		
Utility Problem—Cable Relocation Offers Challenge on San Lorenzo Cr. Bridge Job	Jan. - Feb.	64
Amador County		
Carson Spur—Public's Patience Eases Job of Widening on Highway 88	Jan. - Feb.	11
Contra Costa County		
Cummings Skyway, Taylor Boulevard Jobs	Sept. - Oct.	60
Del Norte County		
U.S. 199 Tunnel—Work Begins on Relocation of Highway	May - June	27
Hazelview Summit Tunnel named "Randolph Collier Tunnel"	Jul. - Aug.	33
El Dorado County		
Aukum Road—El Dorado County Completes Difficult Route Relocation	Mar. - Apr.	27
U.S. 50 near base of Lovers Leap —1912	Jul. - Aug.	61
Humboldt County		
Scotia Bridge—Parallel 2-lane Structure Corrects Traffic Deficiency	Mar. - Apr.	24
Imperial County		
Sand Hills—Historic Dunes Section of U.S. 80 Being Reconstructed as Freeway	Jul. - Aug.	11
Kern County		
U.S. 466—First Section Completed between Bakersfield and Tehachapi	Mar. - Apr.	35
Los Angeles County		
Loop Progress-L.A. Freeway Completions Will Bring Traffic Relief	Jan. - Feb.	13
Cast-in-hole Piles Used on Loop Job	Jan. - Feb.	14
L.A.R.T.S. — Huge Cooperative Study Is Key to Metropolitan Area Planning	Jan. - Feb.	32
Arroyo Seco—Pasadena Freeway, First in West, Has 20th Birthday	Jan. - Feb.	57
Elysian Viaduct—Key Structure in Complex L.A. Interchange Nears Completion	Sept. - Oct.	11
L.A. Renaissance—Freeway Service Key Factor in Downtown Growth, Renewal	Sept. - Oct.	29
Marin County		
Nicasio Road—Construction of Dam Requires Relocation of F.A.S. Highway	Jul. - Aug.	49
Merced County		
New 17 Mile Road Los Banos F.A.S. Project	May - June	43
Monterey County		
Salinas Valley—New U.S. 101 Freeway Sections Bring Traffic Relief	Mar. - Apr.	52
Los Laureles Grade—New Road Saves Time, Distance	Mar. - Apr.	69
Napa County		
State, Local Agencies Cooperate in Improving Highway Drainage	Mar Apr.	56
Riverside County		
Corona Bypass—Riverside Freeway Now Continuous for 24 Miles	Jul. - Aug.	27
Sacramento County		
Merging Traffic—North Sacramento-Elvas Freeway Interchange Subject of Study	Jul. - Aug.	44
Rural Fringe—Freeway Speeds Increase in Land Use, Land Value.	Mar. - Apr.	30
San Bernardino County		
Two F.A.S. Jobs—San Bernardino County Adds 4 Important Miles	Jan. - Feb.	54
Needles—U.S. 66 through Downtown Area Is Four-laned, Straightened	May - June	56
Barstow Bypass U.S. 66-91 Freeway Extended Nine Miles.	Sept. - Oct.	57
Baker Grade—25 Miles of U.S. 91-466 Become Full Freeway	Sept. - Oct.	2
Big Bear Loop—New 16-Mile Highway Opens Up Recreation Area	Sept. - Oct.	15
San Diego County		
4-Level Interchange—New U.S. 101-395 Connection Is Under Way in San Diego	Mar. - Apr.	61
U.S. 80—San Diego—Another Eight-lane Section Is Completed	May - June	23
U.S. 80 at El Cajon—Two New Freeway Sections Opened this Year	Sept. - Oct.	64
San Francisco County		
Temporary Sightseeing Area Installed on Section of Embarcadero Freeway	Mar. - Apr.	2
J.H.D. No. 9—33-Year Old Cooperative Program to Improve Sign Route 1 Concluded	Mar. - Apr.	67
San Joaquin County		
Harding Way—Traffic Flow in Stockton Aided by New Underpass	Jan. - Feb.	66
San Luis Obispo County		
Pismo Beach—City Street Section on U.S. 101 Eliminated	Jul. - Aug.	2
San Mateo County		
J.D.H. No. 9	Mar. - Apr.	67

Sept. - Oct.

Jan. - Feb.
Jan. - Feb.
Jul. - Aug.
Jan. -
Jan. -
Jul. -
Mar. -
- Feb.
- Feb.
May -
Jul. -
- Aug
Jan. -
- Oct.

Jul. - Aug.

Mar. - June
Jul. - Aug.

Mar. -

Jul. -
Sept. -
Jan. -
- Aug.
- Apr.

Proposed
ture Corrects Traffic Deficiency
Mar. -

- June
- Aug.
- Aug.

Soil Stabilization, Sand Drains Aid in
Sept. - Oct.
- Feb.

Collection
Mar. - Apr.
- Aug.

nas Bridge"
Jul. - Aug.

Jan. - Feb.
Apr

Aug.

Aug.

Feb.

Feb.
June

Oct.

Sept. -

Oct.

June

Oct.

June

June

INDEX OF AUTHORS

Co. Au.
Sept. -

Oct.

June

Oct.

June

June

	Issue	Page
Gard, John—San Mateo Streets—Major Progress Made Under Six-year Program (Co Au.)	Jul. - Aug.	42
Geimer, Ray J.—New 17-mile Road—Los Banos-Turlock F.A.S. Project Opened	May - June	43
Greene, G. A.—Tube Report—Webster Street Underwater Tunnel Will Be Completed by Fall, 1962 (Co Au.)	Jan. - Feb.	25
Greenberg, R. J.—Harding Way—Traffic Flow in Stockton Aided by New Underpass	Jan. - Feb.	66
Griffin, A. D.—Arroyo Seco—Pasadena Freeway, First in West, Has 20th Birthday	Jan. - Feb.	57
Hart, Alan S.—Progress on U.S. 40—Carquinez to Sacramento (Co Au.)	Sept. - Oct.	7
Himelhoch, A. L.—Loop Progress—L.A. Freeway Completions Will Bring Traffic Relief	Jan. - Feb.	13
Hollister, L. C.—Bridge Progress—Benicia-Martinez Job Completion Scheduled for Summer of 1962	Jul. - Aug.	18
Jansen, P. B.—Flood Problems-2—Guadalupe River Co-operative Drainage Project	May - June	74
Jesperson, J. A.—U.S. 80 at El Cajon Two New Freeway Sections Opened This Year (Co Au.)	Sept. -Oct.	64
Keleher, J. J.—Traffic Striper—New Machine Now in Service Has Flexibility and Ease of Control	Jul. -Aug.	31
Knutson, Arthur T.—Nicasio Road—Construction of Dam Requires Relocation of F.A.S. Highway	Jul. - Aug.	49
Kocher, Roger F.—Sand Hills—Historic Dunes Section of U.S. 80 Being Reconstructed as Freeway (Co Au.)	Jul. - Aug.	11
Lagsdin, A. S.—Walnut Creek Co-operative Agreement (Flood Problems)	May - June	76
Latchaw, Robert—Contra Costa F.A.S.—Cummings Skyway, Taylor Boulevard Jobs Completed	Sept. - Oct.	60
Leftwich, V.—U.S. 80 at El Cajon—Two New Freeway Sections Opened this Year (Co. Au.)	Sept. - Oct.	64
Marek, Charles E.—Cast-in-hole Piles Used on Loop Job	Jan. - Feb.	14
Marsh, D. Ewing—Painting the Bridge-1—Painted Surface Totals 370 Acres	Jul. - Aug.	5
Painting the Bridge-2—Gantries Aid Bridge Repair	Sept. - Oct.	50
Mauck, C. M.—Needles—U.S. 66 Through Downtown Area Is Four-laned, Straightened (Co Au.)	May - June	56
Mauzy, H. K.—Bridge Costs—1960 Survey Shows Continued Decline (Co Au.)	Mar. - Apr.	73
Mayfield, A. D.—Hydraulic Model—Energy Dissipator Tested in L.A. Laboratory (Co Au.)	Jul. - Aug.	67
McClain, Bruce W.—Los Laureles Grade—New Road Saves Time, Money	Mar. - Apr.	69
McDonald, W. C.—Napa Co-operative Drainage Project	Mar - Apr.	58
McKenzie, D. W.—Watt Avenue—1½-mile F.A.S. Job Includes Bridge, U.S. 50 Connection (Co. Au.)	Sept. - Oct.	25
McKean, K. E.—Hydraulic Model—Energy Dissipator Tested in L.A. Laboratory (Co Au.)	Jul. - Aug.	67
Meyer, J. G.—Progress on U.S. 40—Carquinez to Sacramento (Co Au.)	Sept. - Oct.	6
Morse, Gordon—Elysian Viaduct—Key Structure in Complex L.A. Interchange nears Completion (Co Au.)	Sept. - Oct.	11
Moskowitz, Karl—Barrier Report—Performance of Beam, Cable Types Analyzed (Co Au.)	Sept. - Oct.	18
Mullin, L. E.—Utility Problem—Cable Relocation Offers Challenge on Bridge Job	Jan. - Feb	64
Nash, A. M. Salinas Valley—New U.S. 101 Freeway Sections Bring Traffic Relief to Area	Mar. - Apr.	52
Newman, Leonard—Merging Traffic—North Sacramento-Elvas Freeway Interchange Is Subject to Study	Jul. - Aug.	44
Ng, H. S.—Healdsburg Co-operative Drainage Project	Mar. - Apr.	76
Nicholas, J. L.—Carson Spur—Public's Patience Eases Job of Widening on Highway 88	Jan. - Feb.	11
Nicholas, Martin A.—Two F.A.S. Jobs—San Bernardino County Adds 4 Important Miles	Jan. - Feb.	54
Parker, P. E., Payne, H. L.—U.S. 199 Tunnel—Work Begins on Relocation of North State Highway	May - June	27
Pivetti, Charles A.—Vallejo Freeway—Latest Survey Shows Marked Decline in Accident Rate	Jul. - Aug.	25
Pomeroy, E. G.—Tube Report—Webster St. Underwater Tunnel Will Be Completed by Fall, 1962 (Co Au.)	Jan. - Feb.	25
Porter, Harold—San Mateo Streets—Major Progress Made Under Six-year Program (Co Au.)	Jul. - Aug.	42
Robinson, John C.—California Roadsides—1	Jan. - Feb.	2
2	Mar. - Apr.	40
3	May - June	68
4	Jul. - Aug.	34
Roxburgh, Alfred S.—Circular Letters—New Management Section Streamlines Procedures (Co Au.)	Mar. - Apr.	78
Schaefer, William E.—Barrier Report—Performance of Beam, Cable Types Analyzed (Co Au.)	Sept. - Oct.	18
Sedgwick, W. D.—Maintenance in VII—District's Program Grows to Meet Needs	Jul. - Aug.	52
Shaver, John W.—L.A.R.T.S.—Huge Co-operative Study Is Key to Metropolitan Area Planning (Co Au.)	Jan. - Feb.	32
Shepard, D. S.—4-Level Interchange—New U.S. 101-395 Connection Is Under Way in San Diego	Mar. - Apr.	61
Shurtleff, A. B.—Hydraulic Model—Energy Dissipator Tested in L.A. Laboratory (Co Au.)	Jul. - Aug.	67
Silva, M. F.—U.S. 466—First Freeway Section Completed Between Bakersfield and Tehachapi	Mar. - Apr.	35
Sinclair, J. P.—Bay Area Freeways	May - June	3
Smith, James R.—Remainder Parcels—Cooperative State-B.P.R. Appraisal Study Underway	Jan. - Feb.	38
Smith, N. B.—San Mateo Streets—Major Progress Made Under Six-year Program (Co Au.)	Jul. - Aug.	42
Spencer, Charles E., Jr.—Legal Decisions—State Supreme Court Rules on Three Property Valuation Cases	Sept. - Oct.	46
Stark, Milton C.—L.A. Renaissance—Freeway Service Key Factor in Downtown Growth	Sept. - Oct.	29
Stratfull, Richard F.—Culvert Life—New Test Methods Estimate Life Expectancy of Pipe (Co Au.)	Jan. -Feb.	43
Suenderman, H. C.—Flood Problems—State, Local Agencies Cooperate in Improving Highway Drainage (Co Au.)	Mar. - Apr.	56
Switzer, B. A.—Driver Training—Departmental Program Covers Testing of 13,300 Employees	Mar. - Apr.	64
Telford, E. T.—L.A.R.T.S.—Huge Co-operative Study Is Key to Metropolitan Area Planning (Co Au.)	Jan. - Feb.	32
District VII—Freeway Completions, Current Construction Add Up to Encouraging Progress Picture	Mar. - Apr.	3
Thomson, George W.—Scotia Bridge—Parallel 2-lane Structure Corrects Traffic Deficiency	Mar. - Apr.	24
Waldeck, F. T.—Watt Avenue—1½-mile F.A.S. Job Includes Bridge, U.S. 50 Connection (Co Au.)	Sept. - Oct.	25
Wanee, L. D.—C.T.B.—Improved Spreading Devices, Control Methods Speed Work	Jan. - Feb.	49
Warren, Claude N. and Elizabeth Von Till, Archaeology—State Agencies Cooperate to Save Midden Sites (Co Au.)	May - June	45
Warren, W. L.—Interchanges—Spacing, Design Must Be Individually Tailored	May - June	32
Weber, W. G.—Marsh Area Fill—Sand Drains Aid in Soil Stabilization (Co Au.)	Sept. - Oct.	74
White, Walter W.—Design Course—Bridge Dept. Conducts Own Correspondence Lessons	Jan. - Feb.	69
Yusavage, W. J.—Bridge Costs—1960 Survey Shows Continued Decline (Co Au.)	Mar. - Apr.	73
Zube, Ernest—Asphalt Test—Ten different Road Samples Show Varying Durability	May - June	59

A.S.C.E. CONVENTION ANNOUNCED

The San Diego section of the American Society of Civil Engineers has announced that the Pacific Southwest Council convention will be held in San Diego on April 5, 6, and 7.

'Tempus Fugit' Corner

The following items appeared in the January and March 1937 issues of *California Highways and Public Works.*

". . . All this evidence leads to the unalterable conclusion that the states are not yet ready to assume the economic problems involved in starting a program for divided highways. It is doubtful that such a program is even needed in most of our states. In most of the others, it appears that state highway authorities do not have sufficient control over highway revenues to meet the enormous costs of this type of a program.

"At the same time, I am not so pessimistic that I think the day will never come when such a program will be possible. It is my opinion that we state highway authorities, in future planning, should make provisions for such a program by insisting upon adequate design and adequate right-of-way. This is particularly true with regard to the design and construction of new highways."

(Excerpt from address by Murray D. Van Wagoner at A.A.S.H.O. convention in San Francisco.)

* * * * *

Bridge conscious in a large way, the people of the San Francisco Bay metropolitan area, with the San Francisco-Oakland Bay Bridge a reality, are looking forward with eager anticipation for the opening to traffic of the Golden Gate span, largest over-water suspension structure in the world.

THIRTY PROJECTS ADVERTISED

During December the Department of Public Works advertised for bids on 30 highway projects with an estimated value of $25,189,700. Since January 1, 1961, projects for $378,904,800 have been advertised. There were 30 contracts for $9,496,900 awarded during the month and 47 contracts for $40,863,800 were completed.

During December bids were opened for 26 projects for which 178 contractors' bids were received, an aver- of 6.8 bidders per project.

New Symbol Signs On State Highways

Motorists will encounter two new types of signs on California's state highways within the next few months.

The new signs will use symbols to indicate courses of action to be taken by the driver. Studies have indicated that drivers generally understand and act on the symbols more rapidly than on written instructions, according to the Division of Highways.



Above, on the left, is the sign which will be used to indicate a decrease in the number of lanes (in this case from three lanes to two). On freeways, before they come upon this symbol, drivers will be alerted by a sign saying, "Lane Ends, Merge Left." Variations of this symbol will depend on the number of lanes involved and direction of the merging movement.

When going from divided highways to nondivided highways having fewer lanes, a sign saying "End Divided Road" will precede the symbol which will indicate which lane is to be dropped in order to accomplish the merger. The present multiarrowed signs, which have been used on freeways to indicate a decrease in lanes ahead, and the lettered signs used on other state highways will be replaced as they wear out or are damaged.

On the right, above, is the sign which will be used in the future to indicate a winding road.

Just before the first turn of the winding road, a curve sign already in use will indicate the direction of the initial curve and usually the speed at which it can be safely taken. The new winding road sign will be located just beyond the first curve and will replace the present sign which spells out "Winding Road." The older signs will be replaced as they wear out or are damaged.

Both new signs have been recommended for use throughout the nation by the National Joint Committee on Uniform Traffic Control Devices.

R. C. "Cass" Kennedy

The many friends of Rolland Cashel (Cass) Kennedy, former secretary of the California Highway Commission, were saddened by his death on January 30 in the Veterans Administration Hospital in Oakland after a brief illness.

He had only recently accepted a position with the Engineering and Grading Contractors Association of California, and was driving home to Sacramento after making business contacts in Stockton, when he became ill.

He was a native of Wisconsin. He attended grade schools in Oregon, and majored in electrical engineering at the University of Oregon. He followed this profession for a number of years and then branched out into various other fields.

For several years he was with the *Oakland Tribune* in the automobile section, writing up the motorlog trips. Then he went into business for himself in public relations and advertising.

Kennedy was appointed secretary of the Highway Commission in November 1950 and served in that capacity until December 31, 1954.

During the four years he was secretary, he was the author of numerous articles for *California Highways and Public Works*, among which were the series "Early Days," a history of the commission.

He is survived by his wife, Florence; a son, Robert C. Kennedy of Reno; a daughter, Mrs. Florence Bartlett of Massachusetts, and seven grandchildren.

UNUSUAL ACCIDENTS DAMAGE BRIDGES

Several unusual accidents damaged state highway structures recently.

The day after Christmas an overheight hay truck knocked down the falsework on the Los Osos Road interchange on US 101 near San Luis Obispo.

A similar accident occurred when a high load traveling on Sign Route 23 in Long Beach struck the Studebaker Road overcrossing, completely shattering a prestressed concrete girder.

A United States Coast Guard cutter, answering a distress call from a yacht on fire, rammed the Sign Route 1 bridge across Elkhorn Slough when its reverse gear jammed.

Files Supervisor Coral Davis Retires

Coral Porter Davis, supervising file clerk at headquarters office of the Division of Highways, has retired after more than 40 years of state service.

Mrs. Davis started working for the Division of Motor Vehicles in 1918 and after three years came to the Division of Highways. She was employed as the stenographer for the entire drafting section of the division under office engineers Andrew W. McCurdy, Fred J. Grumm, and L. V. Campbell, successively.



CORAL P. DAVIS

In 1928, she transferred to the file room as a clerk, where she remained and worked up to the position of being in charge of headquarters files and mail.

She is a native Sacramentan. Her mother, Addie Shields Porter, came to Sacramento in 1869 from Portland, Maine, via the Isthmus of Panama and San Francisco.

Mrs. Davis was active in Civilian Defense during World War II and the Korean War, putting in 1,500 hours at the filter center and 350 hours as a Red Cross nurse's aide.

She is a past president of Sutter Parlor No. 111, Native Daughters of the Golden West; a member of Naomi Chapter, Order of Eastern Star, of the Sierra Camera Club, and of the Sierra Club. She is Directoress of the Altar Guild, St. Paul's Episcopal Church, and a member of the Executive Board of Episcopal Church Women of that church.

She has three children—a son and two daughters, nine grandchildren, and a great-granddaughter.

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

HIGHWAY TRANSPORTATION AGENCY

ROBERT B. BRADFORD . . . Administrator

DEPARTMENT OF PUBLIC WORKS . . . ROBERT B. BRADFORD, Director

FRANK A. CHAMBERS . . Chief Deputy Director

RUSSELL J. COONEY . . Deputy Director (Management)
HARRY D. FREEMAN . . Deputy Director (Planning)

T. F. BAGSHAW . . . . Assistant Director
JOHN H. STANFORD . . . Assistant Director

JUSTIN DuCRAY Departmental Management Analys
S. ALAN WHITE . . Departmental Personnel Office

DIVISION OF HIGHWAYS

J. C. WOMACK . . . State Highway Engineer, Chief of Division

CHAS. E. WAITE . . . Deputy State Highway Engineer
J. P. MURPHY . . . Deputy State Highway Engineer
J. A. LEGARRA . . Deputy State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
GEO. LANGSNER . . Assistant State Highway Engineer
FRANK E. BAXTER . Assistant State Highway Engineer
E. R. HIGGINS . . . . . Comptroller
L. L. FUNK . . . . . Planning Engineer
MILTON HARRIS . . . . . Construction Engineer
F. N. HVEEM . . . Materials and Research Engineer
H. B. LA FORGE . Engineer of Federal Secondary Roads
SCOTT H. LATHROP . Personnel and Public Information
H. C. McCARTY . . . . . Office Engineer
A. M. NASH . . . . . Systems Research Engineer
E. J. L. PETERSON . . Program and Budget Engineer
F. M. REYNOLDS . . . . Planning Survey Engineer
EARL E. SORENSON . . . . . Equipment Engineer
E. L. TINNEY . . . . . Maintenance Engineer
W. L. WARREN . . . . . Engineer of Design
G. M. WEBB . . . . . Traffic Engineer
M. H. WEST . Engineer of City and Co-operative Projects
A. L. ELLIOTT . . . . Bridge Engineer—Planning

L. C. HOLLISTER . Bridge Engineer—Special Projects
I. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area

Right-of-Way

RUDOLF HESS . . . . . Chief Right-of-Way Agent
DEXTER D. MacBRIDE . . . . . Assistant Chief
RAY E. O'BIER . . . . . Assistant Chief
R. S. J. PIANEZZI . . . . . Assistant Chief
JACQUES T. ZEEMAN . . . . . Assistant Chief

District IV

J. P. SINCLAIR . . Assistant State Highway Engineer

District VII

E. T. TELFORD . . Assistant State Highway Engineer

District Engineers

SAM HELWER . . . . . District I, Eureka
H. S. MILES . . . . . District II, Redding
ALAN S. HART . . . . . District III, Marysville
L. A. WEYMOUTH . . . . District IV, San Francisco
R. A. HAYLER . . . . . District IV, San Francisco
E. R. FOLEY . . . . . District V, San Luis Obispo
W. L. WELCH . . . . . District VI, Fresno

CALIFORNIA HIGHWAY COMMISSION

ROBERT B. BRADFORD . Chairman and Director of Public Works
JAMES A. GUTHRIE . . Vice Chairman San Bernardino
ARTHUR T. LUDDY . . . Sacramento
ROGER S. WOOLLEY . . . San Diego
JOHN ERRECA . . . . . Los Banos
ABRAHAM KOFMAN . . . San Jose
FRANKLIN S. PAYNE . . Los Angeles
JACK COOPER, Secretary . . . Sacramento

A. L. HIMELHOCH . . . . District VII, Los Angel
GEORGE A. HILL . . . . District VII, Los Angel
C. V. KANE . . . . . District VIII, San Bernardi
C. A. SHERVINGTON . . . . District IX, Bish
JOHN G. MEYER . . . . . District X, Stockt
J. DEKEMA . . . . . District XI, San Die
HOWARD C. WOOD . . . . . Bridge Engine State-owned Toll Bridg

DIVISION OF CONTRACTS AND RIGHTS-OF-WAY (LEGAL)

ROBERT E. REED . . . . . Chief Counsel

GEORGE C. HADLEY . . . . . Assistant Chief
HOLLOWAY JONES . . . . . Assistant Chief
HARRY S. FENTON . . . . . Assistant Chi

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

NORMAN C. RAAB . . . . Chief of Division
BEN BALALA . . . . . Principal Bridge Engineer

DIVISION OF ARCHITECTURE

ANSON BOYD . . . State Architect, Chief of Division

HUBERT S. HUNTER . . Deputy Chief, Administrative
EARL W. HAMPTON . . . . . Deputy Chief, Architecture, Engineering, and Construction

ADMINISTRATIVE SERVICE

Headquarters Office

W. R. VICK . Principal Architect—Project Management
IAN LEE WATSON . Supervisor of Project Coordination
THOMAS CHINN . Supervisor of Scheduling and Control
HENRY R. CROWLE . . Administrative Service Officer
I. I. LEVINE . . . . . Accounting Officer
W. F. PARKS . . . . Supervisor of Office Services
JUSTIN DuCRAY . . . Division Management Analyst
SLADE S. LINDEMON . . . . . Training Officer
FRANK B. DURKEE, JR. . . . . Information Officer

Los Angeles Office

T. LEWANDOWSKI . Supervisor of Project Management
ALAN A. HIMMAH . . Administrative Service Officer

ARCHITECTURE AND ENGINEERING SERVICE

Headquarters Office

ARTHUR F. DUDMAN . . . Assistant State Architect
CARLTON L. CAMP . . . . Principal Architect
EDWARD G. SCHLEIGER . . . . Principal Estimator
CLIFFORD L. IVERSON . Chief Architectural Draftsman
JOHN S. MOORE . . . Supervisor of Special Projects
GUSTAV B. VEHN . . Chief Specification Writer
O. E. ANDERSON . . . Principal Engineer
PRESTON ROCHE . Supervising Mechanical Engineer
ANDREW LOUARGAND . Supervising Electrical Engineer
A. H. BROWNFIELD Supervising Structural Engineer

Los Angeles Office

TOM MERET . . . . . Assistant State Archit
JAMES A. GILLEM . . . . . Principal Archit
CHARLES PETERSON . . Principal Structural Engine
LESTER H. MULLEN . . . . . Principal Engine
C. W. RHODES . . Supervising Mechanical Engine
LEONARD CHERNOFF . Supervising Electrical Engine
ROBERT J. PALEN . . . . . Supervising Estima
R. J. CHEESMAN . . . Chief Architectural Draftsm
H. C. JACKSON . . Supervising Specification Wri

CONSTRUCTION SERVICE—CHARLES M. HERD . Chief Construction Engineer

Area Structural Engineers Schoolhouse Section

F. W. CHEESEBROUGH . . . Area I, San Francisco
M. A. EWING . . . . . Area II, Sacramento
ERNST MAAG . . . . . Area III, Los Angeles

Area Construction Supervisors

THOMAS M. CURRAN . . . . . Area I, Oakla
J. WILLIAM COOK . . . . . Area II, Sacrame
CLARENCE T. TROOP . . . . Area III, Los Ange

DIVISION OF AERONAUTICS

CLYDE P. BARNETT . . . . . Director, Chief of Division

printed in CALIFORNIA STATE PRINTING OF



NOW

Time was when a signing crew like the one from the Southern California Automobile Club shown at right could put a stack of signs in the truck, throw some posts on the racks, and sign several miles of highway before lunch. For a clue as to how long ago that was, note that the tread on the left rear tire of the vehicle says "NON SKID".

In contrast, at the top of the page is a photo of the largest highway sign ever erected in California, possibly in the whole world. Recently placed on the Santa Monica Freeway in Los Angeles, the sign was too large for standard plans, and had to be especially designed by the bridge department of the California Division of Highways. The photos below were made while the sign was being erected.

The 25-ton structure, costing more than $20,000, is 172 feet long, with a clear span of 155 feet between uprights. Like all such large "bridge" type signs, it will have indirect fluorescent lighting, and service walkways fitted with railings which fold out of the way when not in use.

THEN









SEATTLE PUBLIC LIBRARY
4TH & MADISON
SEATTLE 4, WASHINGTON
R56

California Highways and Public Works
DIVISION OF HIGHWAYS
P O Box 1499
SACRAMENTO, CALIFORNIA

RETURN POSTAGE GUARANTEED

BULK RATE
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152



Seattle Public Library
JUN 12 1962
TECHNOLOGY
FILE IN STACK

CALIFORNIA Highways and Public Works



MARCH–APRIL
1962

April 5, 1962

SENATE RESOLUTION NO. 24

By Senators Richards, Arnold, Backstrand, Begovich, Brown, Burns, Christensen, Collier, Dolwig, Donnelly, Fisher, Geddes, Gibson, Grunsky, Holmdahl, Johnson, Lagomarsino, McAteer, Miller, Murdy, O'Sullivan, Quick, Rattigan, Regan, Shaw, Short, Stiern, Sturgeon, Teale, Weingand, J. Howard Williams, and Robert D. Williams.

Senate Resolution No. 24

Relative to the California Highway Commission and the Division of Highways, Department of Public Works

Whereas, Questions have arisen in certain other states over the efficiency, quality and integrity of the highway program in their states; and

Whereas, The State of California has been constructing a system of freeways which is the envy of all the other states and the world; and

Whereas, This tremendous undertaking has been accomplished on a sound and efficient basis and without a whisper of scandal; and

Whereas, This has been due in great measure to the work of the California Highway Commission and the Division of Highways, Department of Public Works, under and pursuant to a legislative plan designed to assure the solution of highway problems on a statewide and community basis, and in the overall public interest; and

Whereas, The successful handling of this great program has been largely due to the consistent, honest and dedicated service of the members of the above Commission and Division; now, therefore, be it

Resolved by the Senate of the State of California, That the California Highway Commission and the Division of Highways, Department of Public Works, are hereby commended for the excellent freeway system now enjoyed by the citizens of this State; and be it further

Resolved, That the Senate of the State of California wishes to express its satisfaction concerning the honesty and the manner in which the commission and the division have carried out the responsibilities delegated to them by law; and be it further

Resolved, That the Secretary of the Senate is directed to transmit a copy of this resolution to the California Highway Commission and the Division of Highways, Department of Public Works.

Resolution read, and unanimously adopted on motion of Senator Collier.

(Excerpt From Senate Daily Journal)

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

Vol. 41 March-April 1962 Nos. 3-4



FRONT COVER—After several years of drought, January and February this year saw the State swept by storm after storm, with snow piling deep in the mountains. One storm which drove far south blanketed the Tehachapis and many parts of Southern California with rare snowfalls, creating many traffic problems (see page 37 et seq.). The aerial photo on the front cover shows US 99, "The Ridge Route," looking south at Gorman, Los Angeles County, just as the snow was beginning to melt. Robert Rose, Photographer.

BACK COVER—Golden foothill country in the summer, with yellow and digger pines, manzanita, and black oak. The road is State Sign Route 49 between Auburn and Grass Valley, on a recently improved section constructed as a two-lane expressway. Photo by John Meyerpeter.



CONTENTS

	Page
Scenic Routes	2
Highways Fish and Game Agreement Set	4
Bayshore Freeway By W. G. Remington, Resident Engineer	5
Freeway Accidents By Karl Moskowitz, Assistant Traffic Engineer	9
More Tests By John L. Beaton, Supervising Highway Engineer, and Robert N. Field, Materials and Research Engineering Associate	15
Fewer Accidents By Glen E. Dillon, District Traffic Engineer	23
Sign Changes By George M. Webb, Traffic Engineer	26
Traffic Safety	28
Onion Valley By R. D. Bottorff, Resident Engineer, Inyo County Road Department	30
Whiskey Creek By J. D. Pettine, Associate Bridge Engineer	33
Snow in the South By John O'Malley, Highway Superintendent	37
Snow! Snow! Snow!	40
L. A. Area Freeways By E. T. Telford, Assistant State Highway Engineer	42
Record Sampling By Lyman R. Gillis, Assistant State Highway Engineer	58
Extra Lanes By David E. Currier, Resident Engineer	61
14th I.T.T.E. Meet	64
Higgins Leaves; Burrill Is Successor	69
District Staff	70
New Routings	71
Howard Wood Retires; Sweet Appointed	73
Bridge Costs	75
In Memoriam	32
Twenty-five-year Awards	32

Retirements

Architecture Loses Four	79	Roy Higgins	69
H. E. Belford	77	Forrest R. Manhart	78
C. R. Burns	78	W. G. Remington	5
Anson Boyd	72	Retirement for 89 Workers	74
George N. Cook	73	Bailey Tremper	78
Fred R. Garrison	77	H. J. Whitlock	77
Henry Hawthorne	77	Howard C. Wood	73

LESTER S. KORITZ, *Editor*

STEWART MITCHELL, *Associate Editor* JOHN C. ROBINSON, *Associate Editor*

HELEN HALSTED, *Assistant Editor*

WILLIAM R. CHANEY, *Chief Photographer*

Editors are invited to use information contained herein and to request prints of any black and white photographs.

Address communications to: EDITOR,

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

P. O. Box 1499

SACRAMENTO, CALIFORNIA

Scenic Routes

Report to Legislature Urges Protection of 'Corridor' Vistas

Governor Edmund G. Brown has proposed the designation of 5,000 miles of "scenic highways" in California "to preserve for future generations of motorists and tourists the beauty of our golden State."

The Governor's proposal was made in approving a report of the Advisory Committee on Scenic Highways and an interdepartmental committee.

The Governor recommended that the committee continue its study and develop specific legislative proposals for the next general session of the Legislature in 1963.

The 48-page report contains 19 recommendations covering highway design, location and right-of-way acquisition policies, roadside facilities and the control of development of "scenic corridors," which include what the motorist sees as he travels as well as the roadway itself.

Most of the 5,000 designated miles of roadway already exist. They traverse every section of the State and include coastal, forest, mountain and desert areas.

The work of the two committees is the second phase of a study ordered by Governor Brown in January 1960, followed by a Senate resolution authorizing the project.

Farr Authors Resolutions

The author of two resolutions in 1960 and 1961 establishing the first study and the two committees was Senator Fred Farr of Monterey County.

"This is a most important report," Farr said. "I am asking the Senate to study it carefully.

"I intend to introduce legislation at the 1963 session of the Legislature to activate this program."

The report, entitled "A Preliminary Plan for Scenic Highways in California," was filed with the Legislature on March 15, Dee W. McKenzie, Chief, Design Section, Highway and Bridge Division, Sacramento County Public Works Department, was chairman of the Advisory Committee on Scenic Highways and Elton R. Andrews, Planning Officer, State Office of Planning, was chairman of the interdepartmental committee.

In his statement on the report, Governor Brown said:

"The advisory and interdepartmental committees have established a sound base for future legislative action to set up a scenic highway system in California.

"I urge the Legislature to study carefully the 19 recommendations in this report. Many of them will require legislative action if we are to protect existing 'scenic corridors' and develop new ones.

"We need particularly to study the problems of city and county participation in the plan to include local routes of interest and beauty where feasible."

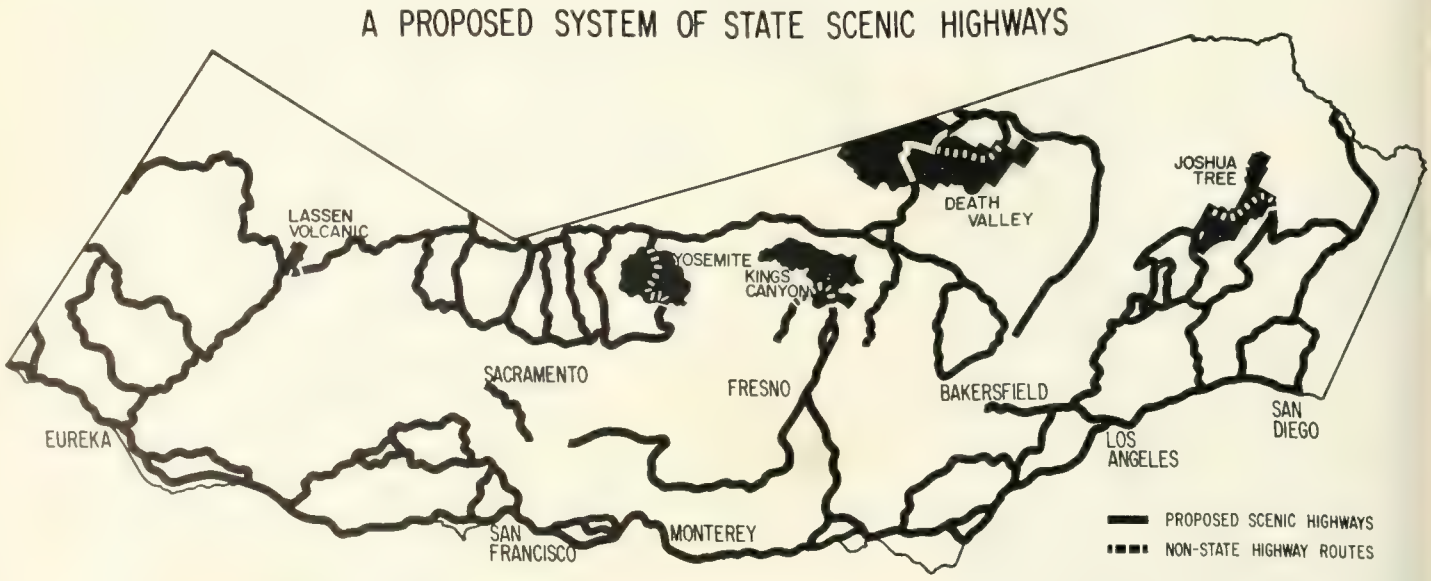
Governor Will Implement

The Governor said that if the Legislature asks the committee to continue to study he will seek specific legislative action to implement the recommendations of the study group.

This study was authorized by Senate Concurrent Resolution No. 39 of the 1961 Legislature.

Among the 19 recommendations of the report:

- Emphasis on scenic values, "appropriately balanced with traffic service and economic factors," in highway location, design and right-of-way acquisition on scenic routes to be designated by the Legislature.
- Necessary legislative action to permit the State to acquire land and easements for "scenic conservation" purposes, and legal clarification of the right of cities



and counties to condemn "scenic easements."

- Increased attention to roadside parks and other public facilities to be planned jointly by the Department of Parks and Recreation and the Division of Highways for use along a designated scenic highway system.
- Review by the Legislature of present laws covering outdoor advertising "to consider whether such existing legislation and its attendant administrative procedures are adequate to protect scenic resources adjacent to designated scenic highways."

A "scenic highway" is defined in the report as one which "traverses an area of outstanding scenic quality, the location and design of which will receive special analysis for the purpose of enhancing the motorist's scenic experience."

The "scenic corridor" concept, as developed by the report, concerns "that part of the landscape abutting a highway route which contains outstanding views, flora and geology, and other unique natural attributes and historical and cultural resources affording pleasure and instruction to the highway traveler."

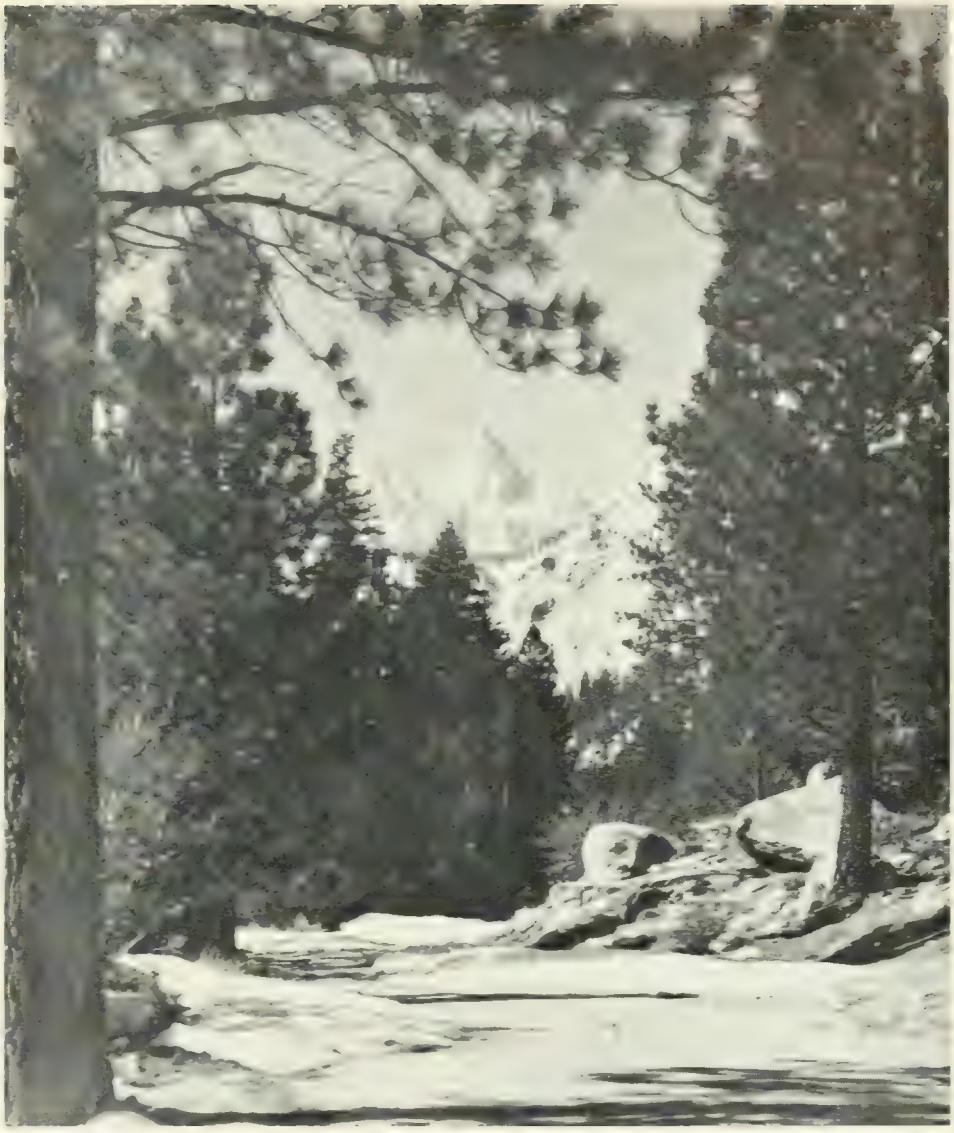
Five General Criteria

The initially proposed scenic highways were selected on the basis of five general criteria. These include the intrinsic scenic values and experiences the route would provide; the diversity of these experiences; the degree to which the route would link specific points or areas of scenic, historical or recreational interest; the relationship to urban areas, for short trips; and opportunities for bypassing major traveled routes.

The advisory committee reported to the two legislators who appointed it, President pro Tempore Hugh M. Burns of the State Senate, and Speaker Jesse M. Unruh of the Assembly.

In addition to McKenzie the advisory committee included:

Harry Schmidt (vice chairman) of Bustine, immediate past president, County Supervisors Association of California; Robert Grunwald of Hanford, landscape architect and planning consultant; Lawrence Livingston, Jr., of San Francisco, planning consultant; Proctor Mellquist of Menlo Park, editor of *Sunset* magazine; Edwin S. Moore of San Francisco, executive vice president, California State Automobile Association; and Charles Perry Walker of Manhattan Beach, immediate past president, League of California Cities.



This photograph of the east face of Mount Whitney, taken from the Whitney Portal road in Inyo County, serves as an appropriate frontispiece for the 1962 Scenic Highways report.

The transmittal of the report by the interdepartmental committee was addressed to the chairmen of the two committees specified in SCR 39: Senator Randolph Collier, Senate Fact-Finding Committee on Transportation and Public Utilities, and Assemblyman Lloyd Lowrey, Assembly Interim Committee on Natural Resources, Planning and Public Works.

Comprising the interdepartmental committee were four directors of state departments: Robert B. Bradford, Public Works; Charles A. De Turk, Parks and Recreation; DeWitt C. Nelson, Conservation; and William E. Warne, Water Resources; plus Elton R. Andrews, Planning Officer, State Office of Planning, Department of Finance.

Conference Promotes Uniform Signs, Signals

More than 50 representatives of state, city and county government units and of automotive organizations met in the State Public Works Building February 12 in a conference designed to promote greater traffic safety through adherence to uniform traffic control devices which are expected to minimize confusion on the highways.

The meeting was one of 12 regional conferences scheduled throughout the country. Present were engineers and officials of Arizona and Nevada, the U.S. Bureau of Public Roads, the California Division of Highways and of a number of California cities and counties.

The conference was sponsored by the American Association of State Highway Officials, American Municipal Association, and National Association of County Officials.

State Highway Engineer J. C. Womack of California in opening the meeting pointed out that as motor trips lengthen and traffic increases on improved highways greater dependence on uniformity in traffic control is more than ever necessary.

Uniformity will be encouraged by a Manual on Uniform Traffic Control Devices prepared by a national joint committee and accepted by the U.S. Bureau of Public Roads, the American Association of State Highway Officials and other groups. The meeting was part of a co-operative effort to put the provisions of the manual into effect.

Signs and signals will have the same meaning throughout the United States, and motorists of any locality will be trained to drive anywhere in the country, reducing ill will and confusion, Charles E. Haley, traffic engineer of Phoenix, Ariz., told the meeting.

Pointing out that uniformity is already in force on the National System of Interstate Highways, D. J. Steele, Division Engineer of the U.S. Bureau of Public Roads, Sacramento, said that compliance with the new manual would be required where the federal government participates in new construction on federal aid primary and secondary routes. He said he hoped existing traffic control devices on such roads could be brought to uniform standards by the end of 1966.

Other speakers included S. E. Farin, Regional Engineer, U.S. Bureau of Public Roads, San Francisco; D. W. Loutzenheiser, Chief, Urban Highway Division, U.S. Bureau of Public Roads, Washington, D.C., and G. M. Webb, traffic engineer, California Division of Highways.

It was brought out that some states and local governments will need legislation to enable compliance with some aspects of the new uniform standards.

HIGHWAYS–FISH AND GAME AGREEMENT SET

After extensive staff-level discussions, the Department of Fish and Game and the Department of Public Works have agreed on a joint co-operative approach to situations involving both highway construction and management of fish and wildlife resources.

The joint approach is set forth in an "Memorandum of Understanding" recently executed by the two departmental directors, Walter T. Shannon of Fish and Game and Robert B. Bradford of Public Works, on the recommendation of State Highway Engineer J. C. Womack and Deputy Director of Fish and Game Harry W. Anderson.

Highlights of the agreement are:

• Exchange of advance information on projects in areas populated by fish and wildlife which might be affected by highway construction, and on physical developments proposed by the Department of Fish and Game which might affect stream flows or highway facilities. Should either department desire to comment on the plans of the other, its recommendations are sent to the appropriate District Engineer of the Division of Highways or the Regional Office of Fish and Game.

• Appropriate personnel of each department will become more familiar with the problems and objectives of the other through the exchange and dissemination of technical information.

• Special provisions in particular highway contracts may require contractors to comply with sections of the Fish and Game Code governing practices deleterious to fish and wildlife.

• The Department of Fish and Game may invite attention to instances of damage to fish and wildlife populations from highway construction undertaken before execution of the agreement. The Department of Public Works will investigate all such instances and consult with its sister agency on remedial action and means to finance corrective measures when warranted.

• The planning and construction of highway projects may include measures and facilities to improve conditions for fish and wildlife desired as a betterment by the Department of Fish and Game provided such inclusion does not delay or interfere with the project's primary purpose and the costs of betterment are financed by other than highway funds.

The agreement is based on "the desire of both departments to co-operate to the end that the State's highway program progresses but at the same time without damage, or with a minimum of damage or loss, to the fish and wildlife resources."

Effective date of the agreement is January 19, 1962. It has been given wide dissemination among the district offices of the Division of Highways and regional offices of the Department of Fish and Game.

LUDDY NAMED VICE CHAIRMAN

The California Highway Commission today elected Arthur T. Luddy of Sacramento to serve as its vice chairman for 1962. He succeeds James A. Guthrie of San Bernardino. Luddy has been a member of the commission since February 1959. Director of Public Works Robert B. Bradford is ex officio chairman of the commission.

Bayshore Freeway

San Jose to San Francisco Is Now All Full Freeway

By W. G. REMINGTON, Resident Engineer



ON JANUARY 24, 1962, the last traffic signal on the Bayshore Highway between San Jose and San Francisco was eliminated.

On this date, the Fair Oaks Avenue Overcrossing was opened to traffic with appropriate ceremonies attended by Robert B. Bradford, Director of Public Works; California Highway Commissioners James A. Guthrie, John Erreca and Abraham Kofman; J. P. Sinclair, Assistant State Highway Engineer; L. A. Weymouth, District Engineer, and local city and county officials. These ceremonies and a luncheon were sponsored by the Sunnyvale Chamber of Commerce, together with Chambers of Commerce of other Peninsula cities.

All Is Now Full Freeway

The divided freeway was opened to the public on February 2, 1962. Resurfacing the northbound lanes and cleanup work continued for several weeks but, practically speaking, the final conversion of the Bayshore to full freeway standards was complete on that date.

One can now travel from San Jose to San Francisco, across the Bay bridge and on to Sacramento, a distance of approximately 140 miles, without being stopped by a single traffic signal. With this final conversion there should end the final chapter of the "Old Bayshore Highway" with its frustrating delays to motorists because of traffic signals and traffic accidents, and there should begin a new period of safe high-speed freeway travel between San Francisco and San Jose.

Because of the topography, San Francisco since early days had had two inadequate vehicular outlets to the south: El Camino Real, now US 101, and the road that followed the Bay shore on narrow right-of-way and roadbed, on inferior alignment and grades.

The Bayshore Highway started in 1923 when the Legislature passed an act authorizing the Highway Commission to acquire right-of-way for and to construct a highway from the line separating San Mateo County from the City and County of San Francisco in, to and through San Mateo County at locations designated and selected by the commission, and declared the same to be a state highway. This act authorized any city and/or county to contribute money and/or property to assist in the construction and maintenance of this road. At the same time, the act provided for the reception and use of the monetary and land denotations and created a special fund for these denotations.

Traffic on El Camino Real, which connected and traversed the various Peninsula cities had long since reached an intolerable stage the entire length of the road from San Francisco to San Jose, and the Bayshore Highway was envisioned as an ultimate solution to the traffic problem. It was planned as a wide commercial highway, with no obstructions, sharp curves, or grades of more than 4 percent.

In 1925, the Legislature extended the Bayshore to a point in the City of San Jose, but stipulated that the State would not spend any state funds for the construction of the Bayshore Highway within the City and County of San Francisco. By 1947, the Legislature had extended the Bayshore Highway to Route 2 (US 101) near Ford Road and included the portion in San Francisco in the State Highway System.

First Contract in 1924

The initial contract for work on the Bayshore was approved in August 1924, with D. A. Foley and Co. of Los Angeles the successful bidder. This contract was for grading only of

W. G. Remington Served Division 41 Years

Wilfred G. Remington, resident engineer in District IV, Division of Highways, has retired after 46 years of public service, 41 years of which were with the division.

Remington was born in Great Falls, Montana, and came to California in 1911.


W. G. REMINGTON

He went to work for Stanislaus County in 1916 as an instrument man and later chief of party. In 1918 he started work for the California Division of Highways in District III but returned to Stanislaus County the following year as Acting Deputy County Engineer, a position he held until 1921. He then returned to the Division of Highways and, except for a short period in private work, has been with the State until his retirement on March 31. He received his appointment as Associate Highway Engineer in 1932. For nearly all of his career with the State he has been a resident engineer on construction projects in Districts III (notably on US 40 over the Sierras), V, and IV. He was resident on projects on the Bayshore Freeway, El Camino Real, and Cabrillo Highway.

He is a member of Elks Lodge 783 in Marysville and Masonic Lodge 690 at San Carlos. He and his wife, the former Florence Smith, have a son, Richard, who works for the Stanford Research Institute.



Lawrence Station Road Interchange on Bayshore Freeway between Morse Avenue and Brokaw Road, looking northerly. Beyond Fair Oaks Avenue Interchange in the center is the newly completed portion between Charleston Road and Morse Avenue.

5.2 miles of 60-foot roadbed between South San Francisco and Burlingame, for which the contractor bid $298,610. It was estimated that the construction of the necessary culverts and other miscellaneous items would bring the cost to $400,000. At this time, San Francisco was the sole contributor, having contributed $400,000.

Ground-breaking ceremonies were held at South San Francisco on September 11, 1924, with Governor Rolph, Harvey M. Toy, the Highway Commission Chairman, and many other dignitaries taking part.

This highway was constructed in a 125-foot right-of-way with a four-lane 40-foot portland cement concrete roadbed, with 10-foot plant-mixed or asphaltic concrete shoulders. The pavement was of several structural designs, part of which were the 11″—9″—11″ type, 11″ at the edges, then tapering in two feet to nine inches for six feet. Various systems of steel reinforcing were also tried at several different locations.

Early in 1929 the Bayshore Highway had been completed to San Mateo and by August 1933 to Lawrence Station Road, now in Sunnyvale, and by July 21, 1937, to San Jose.

C.H.C. Declares Intention

The California Highway Commission, by several actions between March 1941 and April 1958, declared their intention to convert the Bayshore Highway to a full freeway between the San Francisco-Oakland Bay Bridge and McKee Road in San Jose.

The first work converting the old Bayshore Highway began in 1946, and the total conversion was completed this spring, with a construction cost of $72,119,100 and a right-of-way cost of $42,500,000 for 54 miles of multi-lane freeway.

In San Mateo and Santa Clara Counties, the freeway, in general, closely follows, or parallels, the old Bayshore Highway, the most notable divergences being across Candlestick Cove north of South San Francisco, between South San Francisco and Broadway in Burlingame, and between Bransten Avenue in San Carlos and Spruce Street in Redwood City.

Many interesting features were encountered in constructing the Bayshore Freeway across Candlestick Cove and between Colma Creek near South San Francisco and Spruce Street in Redwood City. In the first contract for building a short section into Candlestick Cove, methods were developed for building the center portion of the roadbed only wide enough for "cats" and "carryalls" to turn and dump well in advance of the main fill, then to widen the fill to force the mud wave normal to the center line of construction. On later construction, when the fill had been undisturbed for over 10 hours, blasting was resorted to, to start the mud flowing again. (See article in November-December 1955 issue of *California Highways and Public Works.*)

Built Over Tidal Flats

Through the section from 16th Avenue in San Mateo to Spruce Street in Redwood City, the new sections were constructed over tidal flats. In these areas, considerable lateral displacement of the new roadbed fills were encountered, in many cases cracking the fills open as much as three feet in width and six or seven feet deep.

In several locations, it was found necessary to build earth struts to support and hold both the bridge ramps and roadway fills. Over these sections a flexible asphaltic concrete pavement was used while sections over stable ground were paved with portland cement concrete.

The last two contracts for completion of the freeway between San Francisco and San Jose were awarded in June and July of 1960. These contracts covered an 11-mile length of highway.

L. C. Smith Company of San Mateo was the contractor on the first which extended from 0.3 mile north of Charleston Road in Mountain View to Morse Avenue in Sunnyvale and included the conversion of

the Mountain View-Alviso Road (State Highway Route 113) to freeway standards from Bayshore Freeway to Borregos Avenue.

This contract included the construction of a two-quadrant cloverleaf interchange at Rengstorff Avenue, a four-quadrant cloverleaf at Stierlin Road, a diamond interchange at Ellis Street with a railroad grade separation at the same location, a four-quadrant cloverleaf at Mathilda Avenue and Bayshore Freeway, and a diamond interchange at North Mathilda Avenue and Route 113.

This contract included the relocation of the railroad spur leading into and within the grounds of the U.S. Naval Air Station at Sunnyvale, commonly known as Moffett Field, the relocation of the water supply line and communication system within the air station, and the relocation of the entrance and parking area. This work, approximating $1,000,000, had to be completed before the actual freeway construction could be started.

Project Completed

The resident engineer on this contract was Egon W. Strandberg. With the co-operation between the contractor, U.S. Navy personnel, personnel of Lockheed Missile Plant, officials of Mountain View and Sunnyvale and the resident engineer, the project was completed within the specified time limit.

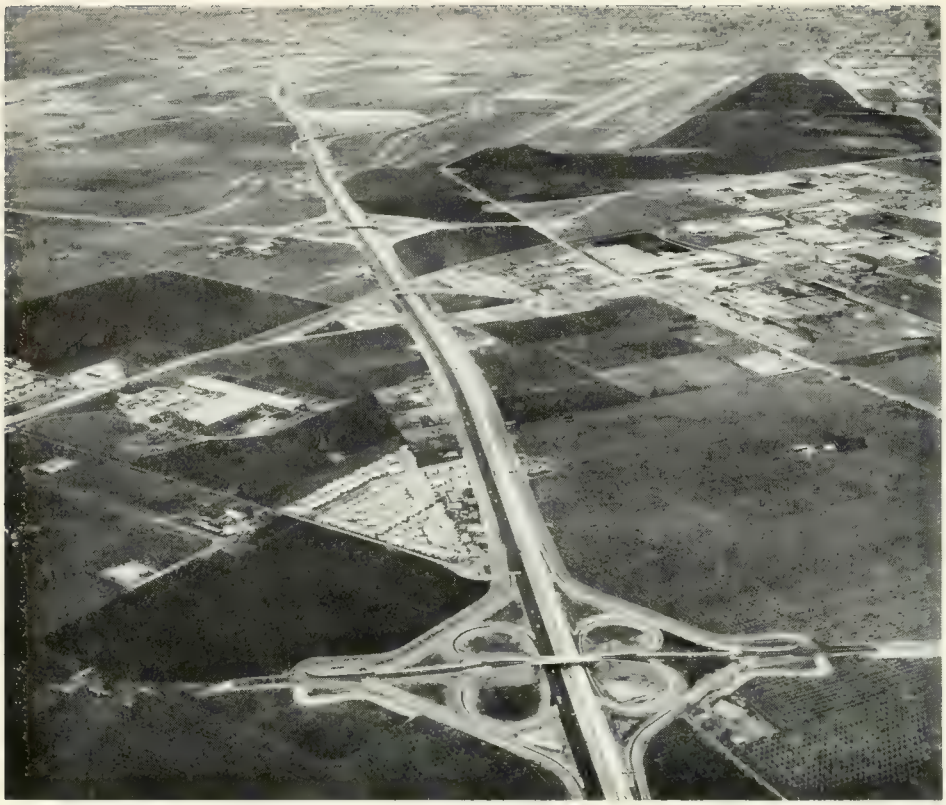
The second of the two contracts, extending from Morse Avenue to Brokaw Road, was awarded to the Allen M. Campbell Company, General Contractors, Inc., of Tyler, Tex. This conversion of the old four-lane highway to a six-lane freeway involved construction of a two-loop, four-quadrant cloverleaf at Fair Oaks Avenue, full four-quadrant cloverleaf interchanges at Lawrence Station Road, San Tomas Boulevard and Trimble Road-De La Cruz Boulevard, a grade separation at Lafayette Street, an overcrossing structure for the future Guadalupe Parkway, a railroad grade separation at the Agnew Underpass, and bridges across Calabazas Creek, Saratoga Creek, San Tomas Aquinas Creek and the Guadalupe River.



Looking northerly from Junction of Interstate 680 and US 101 Bypass at the newly completed portion of Bayshore Freeway between Morse Avenue and Brokaw Road. Guadalupe Parkway Overcrossing structure in center of photograph.



Bayshore Freeway between Morse Avenue and Brokaw Road, showing the structure for the future Guadalupe Parkway in the foreground and the four-quadrant cloverleaf at Trimble Road-De LaCruz Boulevard.



Looking southerly to the City of San Jose on Bayshore Freeway between Morse Avenue and Brokaw Road. San Tomas Boulevard Interchange in the foreground.



Bayshore Freeway looking northerly at a portion of the completed contract between Charleston Road and Morse Avenue. In the foreground is Moffett Field Interchange (not constructed in this contract).

Fill on both of these contracts for embankments below four feet below finished grade was obtained by constructing a wider and deeper Guadalupe River channel on new alignment. This was done by co-operative agreement with the Santa Clara County Flood Control District. The material was of a silty nature and required considerable effort on the part of the two contractors to obtain optimum moisture and the required density. The placing of subbase and bases was done in the conventional manner and little difficulty was encountered.

Headerboards Used

The placing of 117,000 square yards of portland cement concrete pavement was required for the construction of 5.8 miles of 36-foot pavement for the project. Paving was done by placing a 24-foot width lane and a later one of 12-foot width. Headerboards and conventional equipment were used in the paving operation.

In order to minimize traffic delay, it was specified that erection of precast, prestressed girders and steel girders for bridges over the existing roadway must be accomplished between the hours of midnight and 6 a.m. Publicity regarding each erection and of any detours involved was disseminated to newspapers and radio stations by the District Office. With this publicity and with adequate warning at the site, these erections took place without incident or complaint from the traveling public.

Prior to the construction, the old portland cement concrete paving started to show considerable distress. The slabs rocked, and spalling at the joints grew. When traffic was shifted to the new lanes, the subsealing of the old pavement was begun. This consisted of pumping air-refined asphalt into holes drilled in the old pavement at 10-foot centers. It was found that by staggering the holes the voids could be more completely filled. Asphalt was pumped at the average rate of 50 gallons per hole, which is evidence that considerable subsurface erosion existed. Subsequent to the subsealing, the resurfacing of the old lanes was accomplished, completing the conversion of the former four-lane highway to a six-lane, future eight-lane freeway.

Freeway Accidents

No Cross Traffic Keeps Rate Low

By KARL MOSKOWITZ, Assistant Traffic Engineer

Freeways are designed to carry large volumes of traffic expeditiously and safely. A freeway is an express highway with the following characteristics:

1. There are separate roadways for traffic in opposite directions, and each roadway has two or more lanes.
2. Crossroads are separated in elevation from the freeway. There is no cross traffic at grade.
3. There is no access between the highway and the roadside, except at specially designed entrance and exit roadways.
4. Traffic enters and leaves the freeway at flat angles and at speeds approaching the speed of traffic on the freeway.

Several photographs of freeways in California are shown in a later section of this report.

At this writing there were 840 miles of freeway open to traffic in California, of which 373 miles are within cities. Although this comprises less than a 10th of the freeway mileage in the United States, many of these miles are subjected to very large traffic volumes, since it is the policy to construct this highest-type of highway in locations where the greatest benefits are provided, both in relief of traffic congestion and in reduction of accidents.



This section of the Roseville Freeway (US 40-99) north of Sacramento has an average daily traffic count of 22,200 and an accident rate of 0.51 per million vehicle miles.

The average traffic volume on California freeways in 1959 was 35,800 vehicles per day, ranging from 4,000 to 210,000. This volume produced 8,800 million (8.8×10^9) vehicle-miles of travel involving 10,000 accidents in 1959. During the three-year period 1957-59 (with mileage and travel increasing each year), there were 21,047 million vehicle-miles and



A ground view of the Roseville Freeway shown in the above aerial.

1959 TRAFFIC FATALITY RATES

	Fatalities	*MVM**	*Fatalities per 100 MVM*
Rural freeways	108	3,052	3.54
Urban freeways	141	5,737	2.46
Total freeways	249	8,789	2.83
All other roads and streets	3,339	59,011	5.66
Totals	3,588	67,800	5.30

* MVM means "million vehicle-miles," i.e. 1,000,000 vehicles moving one mile, or 10,000 vehicles moving 100 miles each, etc.

24,834 accidents. Because this is more experience than has been available in many other jurisdictions, it is thought that some facts regarding these freeways would be of interest to participants in this conference.

Accident Rate Comparison

Table 1 shows the total reported accidents, injury accidents, and fatal accidents on California state highways in 1959, as well as some accident rates.

As may be noted in Table 1, the accident rate, injury-accident rate, and fatality rate on rural state highways other than freeways are about 2½ times as great as the corresponding rates on rural freeways. Urban freeways have a lower fatality rate, but a higher rate of nonfatal accidents than rural freeways.

Direct comparisons of urban freeway accident rates with other urban arterials are almost impossible to make, mainly because data on urban arterials are so difficult to obtain. An indication is given by comparing Columns 3 and 4 of Table 1. Column 4 is a sample of major urban arterials, representing 21 separate sections of road in various urban areas throughout the State. During the three-year period studied, the roads in this sample generated 833 million vehicle-miles and there were 5,135 reported accidents on them. As the table shows, the accident rate on these arterials was more than five times the rate on urban freeways.

1959 traffic fatality rates for California are shown in the accompanying table.

The fatality rate on freeways was just half that on all other streets and highways, rural and urban.

If the 8.8×10^9 vehicle-miles of travel on freeways had been subjected to the hazards encountered on ordinary roads and streets at the rate of 5.66 per 100 million vehicle-miles, they would have resulted in 497 deaths, instead of the 249 that did occur. In other words, freeways then operating in California saved about 248 lives in 1959.

In an attempt to examine the basic reasons for the success of freeways, Table 2 has been prepared. This table shows the accidents and accident rates for the several classes of rural state highways, broken down by kinds of accident.

Elimination of Intersections

The first thing that one notes on looking at this table is that the major credit for the freeway's over-all superiority is owing to the elimination of intersections. The lower line on the table (total excluding intersections) shows that some success also has been had in the application of other design improvements over the years.

The two-lane roads are generally the oldest, followed by three-lane, then four-lane-undivided, and so on across the table headings. Note that the single-vehicle accident rate is far higher on the two-lane roads than on any of the other kinds. This is probably due in part to more sinuous alignment, less width and less roadside clearance than the other kinds.

The reason for the bad showing of the four-lane-undivided highways, as compared with two-lane roads, can be largely accounted for by the fact that

TABLE 1

TOTAL ACCIDENTS, INJURY ACCIDENTS AND FATAL ACCIDENTS REPORTED ON CALIFORNIA STATE HIGHWAY SYSTEM

	All rural state highways, excluding rural freeways (1959)	Rural freeways (1959)	Urban freeways (1959)	One urban area study—conventional highways
Total number of reported accidents	34,574	3,066	6,944	5,135
Number of accidents involving injuries or fatalities	14,519	1,299	3,088	1,653
Number of accidents involving fatalities	1,000	88	111	24
Number of persons killed	1,255	108	141	—
Number of persons injured (not killed)	24,452	2,045	—	—
Ratio of total reported accidents to number involving injuries	2.4	2.4	2.3	3.1
Ratio of injury accidents to fatal accidents	14.5	14.8	27.8	68.0
Ratio of total reported accidents to number involving fatalities	35	35	63	214
Number of reported accidents per fatality	28	28	49	178
Number of injuries per fatality	19	22	—	105
Fatality rate per 10^8 vehicle-miles	8.68	3.54	2.46	—
Injury-accident rate per 10^6 vehicle-miles	1.00	0.42	0.54	1.98
Total accident rate per 10^6 vehicle-miles	2.39	1.00	1.21	6.16

NOTE: National Safety Council estimates for 1958 for U.S.A.:

Fatal Accidents	32,000	Number of Fatalities	37,000
Injury Accidents—Nonfatal	900,000	Number of Injuries	1,300,000
Vehicle-Miles of Travel	662×10^9	Ratio	35:1
Injury Accidents per 10^8 Vehicle-Miles	1.36		
Total Accidents, 1957	10.2×10^6		
Rate per 10^6 Vehicle-Miles	15.5		

trip development, intersections, and cross traffic are more prevalent on this type of road, which is included in this rural table whenever it is outside of city limits. The old two-lane roads near the outskirts of the cities have been widened to four lanes as congestion and cross streets have become prevalent, as a stopgap measure pending construction of freeways. As can be seen by the small mileage of four-lane-undivided highways, California is making considerable progress in retiring this type from state highway duty.

It is of some satisfaction, in studying Table 2, to note that most of the trends are to be expected; the obvious occurs more than the mysterious. Head-on accidents are twice as frequent on two-lane roads, where you must use the opposing lane for passing, as they are on four-lane-undivided roads, and, in turn, they are three to five times as frequent on four-lane-undivided roads as they are on divided highways, including freeways.

Freeway Rate Variation

Freeways in California have been constructed in widely diverse loca-



The Bayshore Freeway south of San Francisco. This is a six-lane freeway with an average daily traffic count of 59,400 vehicles and an accident rate of 0.75 per million vehicle miles.

TABLE 2

ACCIDENTS AND ACCIDENT RATES[e] ON VARIOUS CLASSES OF RURAL STATE HIGHWAYS BY KIND OF ACCIDENT

(California, Calendar Year 1959)

	2-lane		3-lane		4-lane undivided		4-lane[a] divided		Divided,[b] controlled access		Freeway[c]		Total[d]	
Miles	10,450		45		167		210		794		430		12,330	
Million vehicle-miles	8,358		232		976		1,234		3,543		3,052		17,525	
Average daily traffic	2,191		14,239		15,997		16,130		12,224		19,449		3,894	
	No.	Rate[e]	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total reported accidents	19,899	2.38	597	2.57	3,995	4.09	3,591	2.91	6,011	1.69	3,066	1.00	37,640	2.15
Single-vehicle accidents	7,058	0.84	113	0.49	367	0.38	489	0.40	1,532	0.43	862	0.28	10,481	0.60
Collisions between 2 or more vehicles:														
(a) Between intersections:														
(1) Head-on	3,152	0.42	67	0.29	197	0.20	68	0.06	216	0.06	139	0.045	4,220	0.24
(2) Non-head-on	3,675	0.44	203	0.87	966	0.99	953	0.77	2,099	0.59	1,926	0.63	9,941	0.57
(b) At intersections	5,654	0.68	214	0.92	2,465	2.52	2,081	1.69	2,164	0.61	139[f]	0.045	12,998	0.74
Total excluding intersection accidents		1.70		1.65		1.57		1.22		1.08		0.95		1.41

NOTES: (a) 4-lane divided roads have a median separating opposing traffic but roadside assess is uncontrolled.
(b) Divided controlled access roads are nearly all 4-lanes with a few miles of 6-lane. Opposing traffic is separated and there is no access except at intersections. However, intersections at grade are frequent and traffic enters and exits at large angles, approximating 90°. All State highways except freeways require approaching traffic on cross roads to stop before entering or crossing the State highway, unless the intersection is controlled by traffic signals and the light is green.
(c) Freeways are defined in the text.
(d) Total is different from sum of all columns because it includes some highways that are not classified in one of the columns.
(e) Rate is number of accidents per million vehicle-miles.
(f) Accidents at ramps.

TABLE 3

REPORTED ACCIDENTS, MVM, AND ACCIDENT RATES FOR FREEWAYS CLASSIFIED BY NUMBER OF LANES AND TRAFFIC VOLUME

1957-1959, Inclusive

Group No.	Average daily traffic	4-lane			6-lane			8-lane			Variable no. of lanes			Total			
		No. of accidents	MVM	Accidents per MVM	No. of accidents	MVM	Accidents per MVM	No. of accidents	MVM	Accidents per MVM	No. of accidents	MVM	Accidents per MVM	No. of accidents	MVM	Accidents per MVM	Average ADT per group
I	Less than 5,000	36	22	1.60										36	22	1.60	4,000
II	5,000– 6,999	147	132	1.11										147	132	1.11	6,250
III	7,000– 9,999	345	365	0.95	19	14	1.34							364	379	0.96	8,200
IV	10,000– 14,999	1,269	1,518	0.84	2	5	0.38				48	53	0.91	1,319	1,576	0.84	12,200
V	15,000– 21,499	909	1,020	0.89	35	33	1.05				191	188	1.01	1,135	1,241	0.91	18,500
VI	21,500– 31,599	2,772	2,171	1.28	165	275	0.60	50	70	0.70	135	163	0.83	3,122	2,679	1.17	26,100
VII	31,600– 46,499	761	663	1.15	255	298	0.85	42	70	0.60	887	796	1.11	1,945	1,827	1.06	39,800
VIII	46,500– 67,999	233	235	1.01	1,525	1,608	0.95	66	132	0.50	883	751	1.17	2,707	2,726	1.01	55,500
IX	68,000– 99,999				4,393	3,895	1.13	735	610	1.20	2,619	1,761	1.48	7,747	6,266	1.23	91,200
X	100,000–119,999										1,949	1,243	1.51	1,949	1,243	1.57	103,000
XI	120,000–150,000							1,687	1,130	1.49	1,298	823	1.58	2,985	1,953	1.53	142,000
XII	Over 150,000										1,378	1,002	1.35	1,378	1,002	1.37	158,000
	Total	6,472	6,126	1.06	6,394	6,128	1.04	2,580	2,012	1.28	9,388	6,780	1.38	24,834	21,046	1.18	37,000

tions, in relatively short sections, over a period of more than 20 years. Except for the fact that entrance and exit ramp designs have become more generous, the major design features are quite uniform; main line alignment is good for 60 MPH on almost all freeways, and right-hand paved shoulders are provided on all but the earliest few miles. For the past two years, right-hand shoulders are also provided on bridges, but most of the existing freeways provide a clearance of only two feet from the traveled lanes on bridges more than 150 feet long. Minor features such as width of median, type of drainage control, curbs or flush shoulders on the left, are quite variable among the several sections.

In 1959, the latest year for which complete data have been compiled, the 746 miles of freeway in the State were divided into 138 sections for accident analysis purposes. One hundred three of these were geographically separate, and the remaining breaks were introduced where major changes in traffic volume or year of construction occurred.

Average Rates Plotted

Table 3 shows the number of accidents, travel in MVM, and accident rate per MVM for these freeways for a three-year period, 1957-59, arrayed in volume groups and by number of lanes. The average rates for each volume group have been plotted on the accompanying chart "Accident Rate vs. Average Daily Traffic." Omitting groups I and II, which accounted for only 154 of the 21,047 MVM in the study and obviously plotted erratically, an equation was computed to relate the rates to the average daily traffic. It was found that for freeways in 1957-59, as for undivided highways in 1944-50, the accident rate increases as the 0.2 power of the traffic volume. (For this purpose, each year for each section was classified according to the volume during that year.)

Ninety-four of the sections each had more than 30 MVM of experience. Forty-seven had more than 100 MVM each. These 94 sections are plotted by rate and volume on the accompanying chart "Accident Rate vs. Traffic Volume."

It will be seen that many of the sections vary significantly from the average. The statistics for these sections were examined, and it was found that the year-to-year experience for each of them remained almost constant; in other words, the deviation from the average is probably not chance but is owing to some feature or features of the section. So far, we have not been able to identify any physical characteristics that can be expressed numerically, such as width, curve, radius, sight distance, and so on, that would explain why these sections are so much different from the average.

Subjective Appraisal Attempted

A subjective appraisal of physical features of the freeways with better-than-average and poorer-than-average rates has been attempted. In general, the freeways with better rates (lower than average) are more generous in width, they have no curbs either left or right, they have paved flush shoulders, and they have uniform cross sections, i.e. the number of lanes is constant for fairly long distances. The ramps are comparatively generous and are on the righthand side. The alignment is also very good and in many cases absolutely straight. Although these things are true with respect to the sections with better-than-average rates, it must be realized that they are also true with respect to many of the sections with average rates. The one fact that stands out is that, with one exception, the sections with higher-than-average rates all lack one or more of these favorable characteristics.

About half of the sections with higher-than-average rates have curbed medians, most of them are in urban areas (although this is also true of the sections with lower-than-average rates), and there are frequently some design features such as left-hand ramps, curb noses adjacent to the freeway lanes, short ramp terminals, and

rolled gutters, which have been discontinued in later designs. None represents recent design practice; i.e. they were all designed more than five years ago. Again, however, it is emphasized that many freeways with similar features have good accident rates, within 20 percent of the average in either direction.

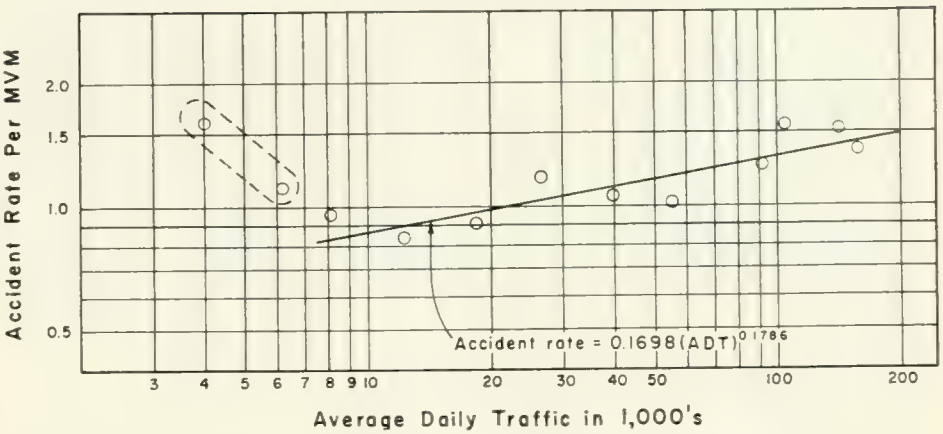
Spacing Is the Same

The average interchange spacing on freeways with higher-than-average rates was almost exactly the same as the spacing on the better-than-average sections.

A study made in 1959[a] showed that accidents involving ramp maneuvers occurred with a frequency of about one accident per million ramp vehicles. Exit ramps showed an average of 1.13 accidents per million vehicles leaving the freeway, and entrance ramps showed an average of 0.93 accidents per million vehicles entering the freeway. No tendency was noted for this rate to be related to traffic volume on the freeway nor to the distance between ramps.

It is easily seen, however, that the number of entering and exiting vehicles will affect the total number of accidents on the freeway, and thus the vehicle-mile rate. If the average trip length on the freeway is five miles, the accidents attributable to ramp maneuvers would themselves account for a vehicle-mile rate of 0.10 to 0.20

Accident Rate vs. Average Daily Traffic,
All Freeways in California, 1957-1959
(Based on 24,834 accidents, on 746 miles,
21,046 million vehicle miles)



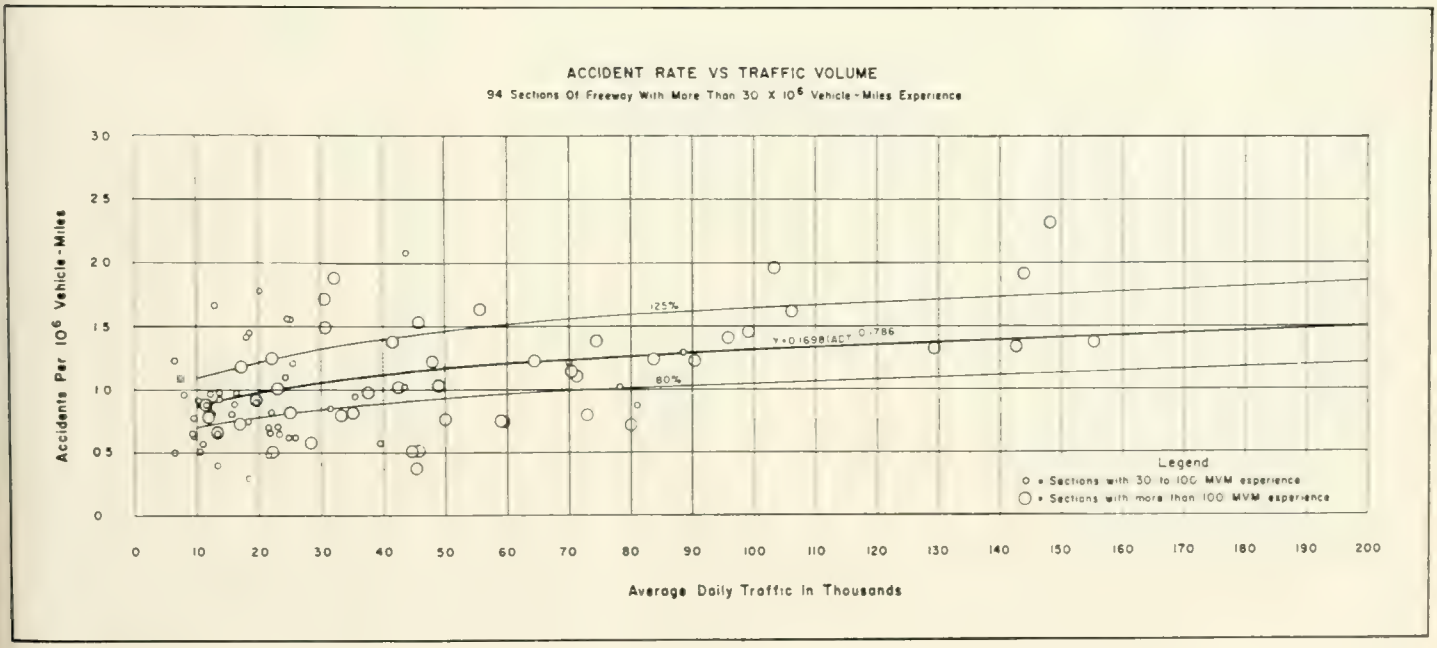
(depending on number of vehicles involved in each accident), which is about 16 percent of the total rate. (In the 1959 study, the ramp accidents actually did amount to 18 percent of the total.)

Average Trip Five to Seven Miles

The number of ramp accidents is not reduced by reducing the number of ramps, unless the number of ramp vehicles is reduced.[b] However, there are many indications that the average length of trip on freeways in large urban areas is about five to seven miles, and whether the interchanges were spaced at half-mile intervals, one-mile intervals, or two-mile intervals would not make much difference in the number of entering and leaving vehicles. One-mile intervals as an alternative to two-mile intervals would reduce the inconvenience, circuity and total vehicle-miles (including street travel) for freeway users, and would result in a greater amount of each trip being completed on the freeway portion of the trip, but it would not change the number of trips. One-

[a] "Accident Experience at Freeway Ramps" by George Langsner. This study examined 895 accidents occurring at 401 ramps on 12 freeway sections totaling 82 miles, over a 3-year period in which 948 million vehicles used the ramps.

[b] If the number of vehicles using ramps could be reduced, the trips would be made on surface streets where the accident rate is five or six times greater than the freeway rate.



mile spacing would also result in smaller, more manageable flow at each ramp than would two-mile spacing.

Although reducing the number of ramps will not reduce the number of ramp accidents, there is reason to believe that improving the shape of the ramps will. This is very difficult to prove numerically, because (a) a ramp shape cannot be expressed as a number, and (b) 80 percent of all ramps, good and bad, have less than two accidents per year. In the 1959 study, 44 percent of the ramps had no reported accidents in a three-year period.

Fatal Accidents

There were 258 fatal accidents on California freeways in 1960, which occurred at 254 locations throughout the State. Based on personal study of original reports of each of these accidents, a subjective summary of them follows:

Fatal accidents are different from other accidents in other ways than severity. They are very scattered geographically, which means that "concentrations" that would point up a geometric design shortcoming do not occur. They seem to be more inexplicable than ordinary accidents, particularly on freeways, and they seem to involve errors of kinds one cannot picture himself making. The classifications by type of maneuver, by hour of the day, and by driver error are different from corresponding classifications of lesser accidents.

Time of Day

Analyses of freeway fatal accidents by time of day have been made previously in California. A study for the three years 1957-59 showed that 37 percent of freeway fatal accidents occurred between midnight and 5 a.m., while only 5 percent of the travel occurred during those hours. The rate per vehicle-mile was 17 times as high during those hours as it was during the hours 7 a.m. to 6 p.m.

The 1960 statistics are very much the same. In 1960, 35 percent occurred between midnight and 5 a.m., and 31 percent occurred during other hours of darkness.

Because of the entirely disproportionate number of accidents occurring between midnight and 5 a.m. as compared with other hours of darkness, there is reason to believe that factors other than visibility account for much of the difference between day and night fatal accident rates.

Type of Accident

A classification of fatal accidents by type of maneuver is given in Table 4.

The interesting thing about Table 4 is that two-thirds of all fatal accidents on freeways involved but one vehicle.

The classification "vehicle left road" requires some explanation. In this context, the road is the paved surface and shoulders between side slopes or curbs or rails. There are no "fixed objects" in the road, and thus every "fixed object" accident involved a vehicle which left the road, even though the final point of rest may have been on the road. However, there are many objects at the edge of the shoulder in the same general plane as the roadway. Except for railings of long bridges, most of these are eight feet or more from the edge of the through pavement lanes. Accidents classified as "left road, did not collide with object" are those which went beyond the edge of the road shoulder, generally onto a different plane, before hitting anything.

It is very difficult to say where a vehicle loses control when it leaves the road, even if all the facts about the accident are known. Indications are that 20 of the 55 accidents in Class 1(b) of Table 4 were spinning, or skidding before leaving the road, and that about the same proportion applies to Class 1(a). Both categories include many cars which overturned.

Fixed Object Collisions

There is little question that many of the "fixed object" collisions would have been fatal even if they had not collided with a fixed object.

Pedestrian accidents accounted for 14 percent of all the freeway fatal accidents in 1960. Freeways are not designed for pedestrians and on most of them, pedestrians are prohibited by law. This is the one type of accident which the vehicle driver has the least opportunity of avoiding.

The classification "dismounted vehicle occupants" includes persons whose cars were disabled and who were outside of the vehicle, fixing a tire, wandering around, fetching gasoline, etc.

Two-thirds of the pedestrian accidents occurred during darkness preceding midnight, and they accounted for one-third of all fatal accidents during those hours.

Driving on Wrong Side of Median. This category of head-on accidents is one of the most difficult to understand. Most of them result when confused drivers enter a freeway going the wrong way on an exit ramp, but sometimes they simply turn around on the road. Ten of the 15 wrong-way drivers were drunk.

One of these accidents involved a car which entered a busy eight-lane metropolitan freeway against heavy

TABLE 4

FATAL ACCIDENTS ON CALIFORNIA FREEWAYS—1960

		No.	Percent
A.	Accidents Involving One Vehicle		
	1. Vehicle left road or overturned	135	52.4
	(a) Collided with fixed object	80	
	(b) Did not collide with object	55	
	2. Pedestrian	37	14.3
	(a) Walking on road	27	
	(b) Dismounted vehicle occupants	10	
	Subtotal	(172)	(66.7)
B.	Head-on Collisions		
	3. Driving on wrong side of median	15	6
	4. Crossed median	28	11
	Subtotal	(43)	(16.6)
C.	Rear-end Collisions	43	16.7
	Total	258	100



The Golden State Freeway in the Los Angeles area. This is an eight-lane freeway. The average daily traffic rate from 1957 to 1959 was 45,000. The accident rate for this period was 0.38 per million vehicle miles.

traffic, with about 3,000 vehicles per hour coming toward him, and drove *four miles* before finally colliding with a car. Hundreds of vehicles veered away from the offending car, using the other three lanes. Why the offending car did not *stop* is the question. Confusion at exit ramps is conceivable, but it is inconceivable how anyone could go on for four miles in the face of this kind of traffic.

Accident Is Exceptional

The accident described was very exceptional. All but two of the other wrong-way fatal accidents occurred during hours of very light traffic flow, in the dark, most of them in rural areas where there was no regular street pattern. The freeways are four-lane freeways, with two lanes in each direction, separated by a median.

Typically, the offending car enters the freeway via an exit ramp, going the wrong way, and drives on the right-hand side (from his point of view) of the two-lane roadway; i.e., the side next to the median. His headlights are on. The nonoffending car, or "innocent victim" comes booming along and sees headlights coming toward him for at least 1,000 feet, perhaps a mile or more. There is practically no other traffic on the road and there is nothing to keep him from pulling to *his* right and avoiding the offending car. Yet he panics, and either stays in the left lane or steers into the left lane.

Car Loses Control

Cross-median Head-on. There were 28 fatal accidents in this classification in 1960. This kind of accident occurs when a car loses control and goes across the median into the face of opposing traffic. Only 3 of the 28 involved drunk drivers, but 10 of the 28 vehicles that went across the median were little cars or sports cars.

Eleven of the 28 occurred on sections where the median is 36 feet wide or wider.

Twenty-two of the 28 cross-median fatal head-on accidents occurred on sections of freeway where the traffic volume exceeds 60,000 per day. Median barriers are being erected on all California freeways where this volume occurs.

Curbs do not prevent nor deter out-of-control vehicles from going across the median. In many cases they probably cause the vehicle to go out of control.

Rear-end Collisions. When the freeway concept originated, it was thought that rear-end collisions would be the most prevalent type. High standards of alignment and width were to eliminate single-vehicle accidents, grade separations were to eliminate intersection collisions, and separated roads for each direction were to eliminate head-on collisions. Pedestrians were to be prohibited. The only kind of accident that was not provided for was the rear-end collision.

Low Fatality Rate

It is therefore very interesting to note that the rear-end collision accounts for only one-sixth of the fatal accidents on California freeways in 1960. Here, of course, is one of the things that is different about fatal accidents. The rear-end or sideswipe is the most prevalent type of accident on freeways, but as the layman surmises, it is not often fatal.

Although trucks are involved in a small percentage of all fatal accidents on freeways, they are involved in a disproportionate share of rear-end fatal accidents.

- Of the 43 fatal rear-end collisions on California freeways in 1960, trucks were involved in 21.
- In 11 accidents, a truck was hit from behind. Two of them involved stopped trucks, and eight of them involved trucks going very slow, well below any speed limit. Raising the speed limit would have no effect on their speed.
- In 10 accidents, a truck overtook the other vehicle and could not or did not stop in time.

The preceding statistics raise serious questions regarding the advisability of raising speed limits for trucks, which is now 50 m.p.h. on California freeways.

Conclusions

Freeways are comparatively safe roads, but they are not foolproof. Their principal advantage is the elimination of cross traffic conflicts.

Two-thirds of fatal accidents on freeways involve only one vehicle. One-third of fatal accidents occur between midnight and 5 a.m., while only one-twentieth of the travel occurs during those hours.

For a prudent driver, the probability of being involved in a fatal accident is very much less than the overall statistics indicate, and the overall rate is 2.26 fatal accidents per 100 m.v.m.

More Tests

Cable-Chain, Rigid Beam Barriers Given Further Lab, Field Study

By JOHN L. BEATON, Supervising Highway Engineer, and
ROBERT N. FIELD, Materials and Research Engineering Associate

SUMMARY

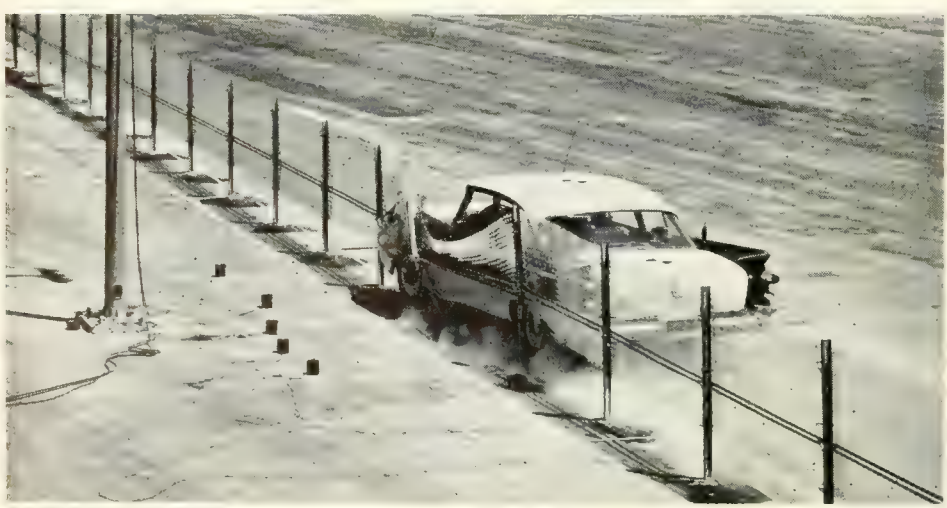
1. *Head-on accidents* were *virtually eliminated* by the barriers. On the Santa Ana and Nimitz test sections, there were 49 cross-median accidents in the "before" period, including eight fatal accidents, and there were two cross-median accidents in the "after" period, one of which was fatal.
2. *Total* accidents and *injury*-accidents *increased* in the locations where barriers were installed.
3. The freeway test sections with the *cable barrier* experienced a *smaller increase* in the overall accident rate than did those with the *beam barrier*. There was no proof that the accidents involving the cable barrier were less severe. However, the findings of the controlled impact tests indicated that high-speed collisions with the cable barrier would result in much less severe injury to vehicle occupants, and it is believed that in general the accidents involving the cable barrier are less severe.
4. The *maintenance cost* of the *cable barrier is considerably higher* than that of the beam barrier. *First cost* of the *beam barrier is much greater* than the cable barrier. It would require some 19.5 years for the total expenditure to balance.
5. More accidents are evident involving the cable barrier. The *proportion of single-vehicle accidents is much higher* with the *cable barrier* than with the beam barrier. There is no indication that drivers are more reluctant to swerve into the beam barrier, but there are indications that there may be more "hit-and-drive-away" accidents involving the cable.
6. There was little difference in the cable barrier accident rate between the sections with 12- and 22-foot medians, and the maintenance cost per mile was essentially the same. There was *no evidence to indicate that the deflection of the cables led to collisions* by permitting momentary encroachment in the opposing lanes.
7. In installations other than the test sections, two vehicles climbed up and over the cable barrier and there were indications that others made partial climbs up the barrier.

During 1959, a full scale dynamic test program resulted in two types of median barriers for use on California Freeways. This program was reported in *California Highways and Public Works* in July-August, 1959.

Following the study, construction of the two accepted types of barriers was started immediately. The first of these installations was classified as experimental and it was planned to report on their performance after the first year of operation. This report was made in the September-October, 1961, issue of *California Highways and Public Works*.

The two types of barriers were the flexible cable-chain link type and the more rigid blocked-out metal beam barrier. The test sections, each approximately six miles in length, were installed on the Santa Ana Freeway in Los Angeles and the Nimitz Freeway in Oakland. Each of these installations was approximately evenly divided between the cable and the beam type barriers.

The one year operational study showed that while both types were successful, some improvements were needed in the cable barrier. Additional full scale tests to develop the improvements were therefor initiated and were performed during the spring and summer of 1961. The results are here reported. The following summary contains the findings of the one year operational study as well as a summary of the results of the recent test program. The detail discussion of one year of operation is included in the July-August, 1959 article.



A test car crashes into the new design cable-chain link barrier at 75 miles an hour. Note the lack of rise of the front of the car during this flat angle collision.

Subsequent controlled collision tests indicated this tendency could be minimized by *removing the lower cable* from the original design.

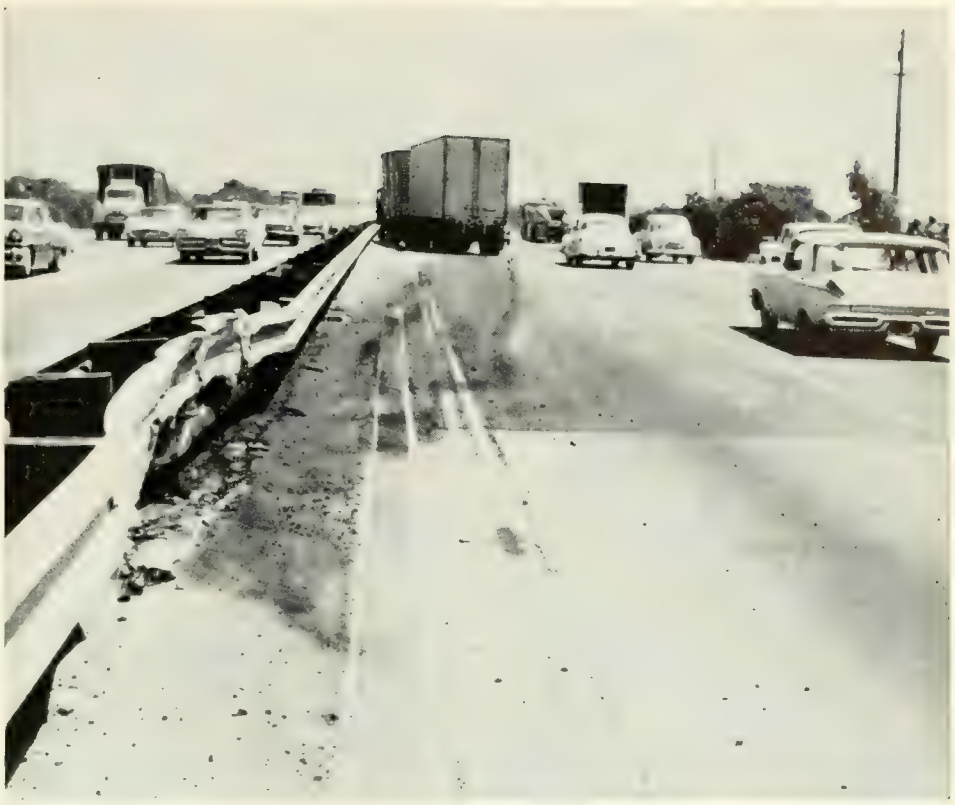
8. In addition to the two vehicles that climbed the cable barrier, two vehicles *jumped barriers*. One on the Santa Ana test section was apparently due to the car striking a curb in front of the barrier. The other was not on the test sections and was judged to be the result of the barrier being too low in relation to the plane of the roadway superelevated surface.

   Subsequent controlled collision tests indicate that a 30-inch-high barrier should be placed at or before the point of intersection of the shoulder slope and ditch slope. If it is necessary to place the barrier down the ditch slope, then it should be placed no farther down the slope than will result in the top of the barrier being at least 27 inches above a horizontal projection from the point of intersection of the slopes.

9. Analysis of controlled collision test results indicate that the cable in a cable-chain link barrier should be placed no higher than *33 inches* above and no lower than *27 inches* above the ground line (or surface of control elevation).

10. Details of design of the cable barrier should be such that *no fixed restraints* exist insofar as the cable clamps or chain link fabric are concerned.

11. *Expanded metal* for a more effective headlight screen substituted in place of the chain link fabric *makes little change* in the cable barrier performance.



Accident damage to blocked-out metal beam barrier on the Nimitz Freeway. Results correlate well with the experimental full scale crash tests of 1959.

OPERATIONAL FAILURES

Special detail studies were made from time to time of all accidents, and in addition of each accident where vehicles passed over, went through, or climbed the barriers. These observations were made of accidents with all installations of the new designs of median barriers rather than only on the test sections.

Overall, during the past year, three vehicles passed over new designs of barriers, three went through, and one came to rest on top of a barrier.

The three crossovers all involved cable barrier. Two of these were the result of jumps due to causes unrelated to the cable barrier and therefore could have occurred over any 30-inch high barrier. One was the result of the vehicle hitting a curb and jumping high enough to clear the barrier cable. The second was a high speed vehicle which jumped over the barrier after leaving the road on the outside of a curve. The barrier in this case was placed in a low ditch section where the roadway had been rotated to provide for superelevation. This provided the car with an inclined ramp from which to jump.

Same Cause

The third crossover and also the case of the vehicle coming to rest on top of the barrier also occurred on cable-chain link designs. The cause was the same in both cases.

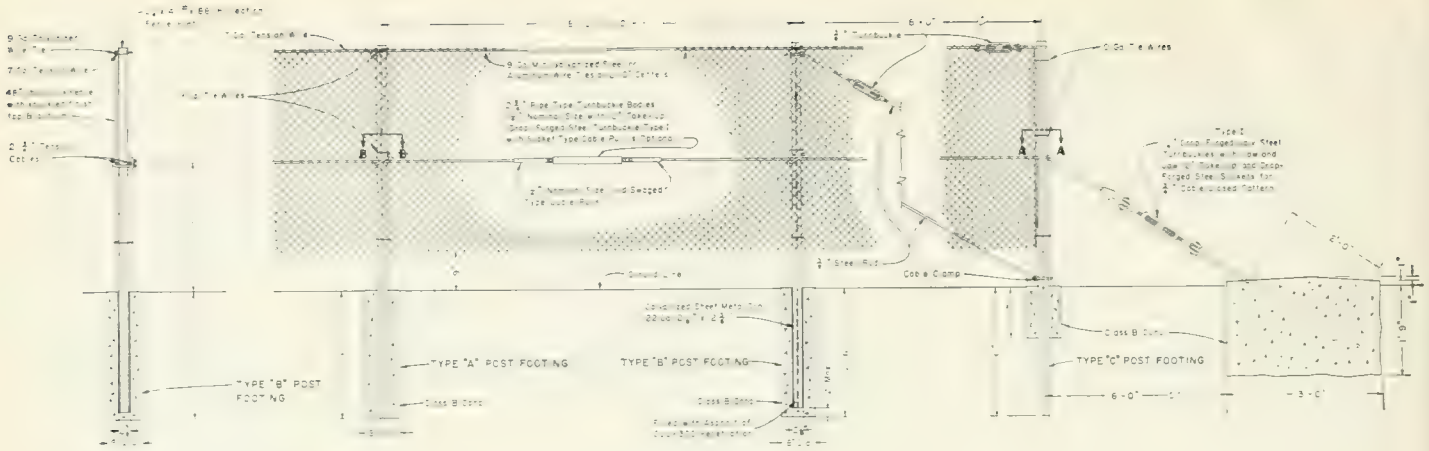
The original cable barrier design called for a tension cable attached nine inches above the ground, and that the chain link fabric be firmly clamped between the lower cable and the post. In both of these accidents and in many others resulting in only partial climbing, it was found that the vehicles approached at a low angle (less than 15 degrees) and high speed. Under these conditions of impact, a post and the firmly secured chain link fabric, combined with the lower cable, served as a ramp for the front colliding wheel to get started in an upward direction. Such a start often elevated the automobile before the car body had an opportunity to penetrate the barrier far enough to provide for restraint by the top cable. Thus the car tended to ride the barrier down.

Two of the penetration type accidents involved trucks colliding with the blocked-out metal beam barrier and resulted in a complete failure of the system. The third penetration involved a small sports car hitting the cable barrier between posts at a high angle of collision and passing between the lower and upper cables. This car had a front end clearance of 29 inches and an overall height of 33 inches, exclusive of the windshield.

Two Categories

A careful analysis of the above barrier crossovers indicates that they could be divided into two categories: one group that probably could be pre-

Solano Public Library
JUN 12 1962



END VIEW ELEVATION

A diagram of the improved design of the cable-chain link barrier. Note the absence of lower cable and alternate designs of post fittings.

cluded by improvements in design and the other that reasonably could not be prevented by a physical barrier. For instance, in the case where the vehicle hit the curb, the car apparently jumped higher than the 30 inches necessary to clear the barrier cable. Since there have been reports of accidents where cars have jumped as high as 8 to 10 feet and in other cases to have cartwheeled, it would not be reasonable to build a barrier high enough to contain every chance accident that might occur.

Because of the required strength involved, it is also not considered practical to design a barrier that will effectively and completely resist the collision of the heaviest trucks. In the two failures on beam barriers that occurred during this past year, the barrier was completely destroyed within the collision area. However, in neither case did the truck penetrate more than a few feet onto the opposing roadway. In other words, even in failure the barriers provided sufficient resistance so as to reasonably contain the vehicles.

The third penetration was an accident unique to the cable barrier in that very small sports cars can penetrate below the top barrier cable under conditions where the angle of collision is relatively high (over 30 degrees). At smaller angles of collision it is probable that the fence post combined with the cable would still function as a positive barrier against penetration of this type of car.

Functions As Expected

Analysis of the above failures indicated that the beam barrier was functioning about as well as could be expected; however, it appeared that further development work should be done on the cable barrier. Studies indicated that it should be possible to make improvements to prevent the tendency of cars to climb the barrier and also that it would be worthwhile to investigate the possible prevention of penetration by sports cars.

The accident in which the car jumped the barrier after leaving the outside of a curve showed that further information should be gathered concerning the effect of differences of grade and elevation on the trajectory of a moving vehicle. Such information could be used to determine the placement of a barrier.

Maintenance of the cable barrier showed certain improvements of details to be desirable. Most of the effort during maintenance was expended in replacing the posts and concrete footings, so this detail was worthwhile of redesign. With one exception, no problems were encountered in maintaining the cables. In one case of collision with the cable barrier, it was necessary to cut the cable so as to remove the vehicle (in this case the vehicle was a truck-trailer combination). This break was repaired by a cable splice using cable clamps and exercised no real problem.

CONTROLLED COLLISION TESTS

In order to develop details to correct the discussed failures, nine full scale tests were performed. In addition to testing corrective details, certain substitute details were also tested. These included (1) alternate post footings, (2) highway guard rail type cable, (3) alternate cable turnbuckles, (4) cable splices, and (5) expanded metal light screen.

Controlled Tests Evaluated

A crossover type of accident considered to be intolerable is where the vehicle climbs the side of a cable barrier and knocks it down as the vehicle passes on over. This type of accident is unique to the cable barrier. As stated previously, analysis of this type of crossover indicated that it was the result of a deficiency in the details of design rather than in the basic flexible barrier concept.

Controlled collision tests for the purpose of analyzing these deficiencies were made at flat angles and high speed; first on the original design, altered only by moving the chain link fabric outside the lower cables, and then by elimination of the lower cable entirely. A total of seven tests were made on designs without the lower cable.

Elimination of the chain link fabric from the lower cable clamps resulted in an improvement in the action. However, high speed moving pictures revealed that the lower cable alone gave the left front end of the car an upward impetus as the front colliding

wheel passed over the junction of the cable and the post. Thus, under certain circumstances it would be possible for the car to continue on upward.

Cable Removal Tested

Removal of the lower cable resulted in penetration of the barrier by the vehicle with no tendency toward upward movement and no loss in barrier action. Post collision investigation of details of the damaged test barriers indicated that the elimination of the lower cable resulted in no loss of barrier effectiveness but did cause a slight loss in stiffness of the system behind the collision. However, any barrier damage due to this loss of rigidity was insignificant.

One of the original design considerations in placing the lower cable in the system was that it would serve to trap the car in the median area as it attempted to return to the onside roadway at the end of the collision path. Operation experience showed that at a flat angle of collision, whether or not the lower cable was in position, the car tended to spin at the end of the collision path back into the traveled lane. This was verified by test collisions.

A review of the accident reports from both the Nimitz and the Santa Ana test sections indicated that this vehicle reaction was typical of a majority of the collisions that occurred on the freeway but that in no case had a secondary collision resulted from this spin out.

Two other details of construction were tested and adopted as a result of these studies. The original design called for a standard turnbuckle every 500 feet along the cable. Since the smoothness of deceleration of the colliding vehicle with the cable-chain link barrier depends primarily upon the friction brake effect of the cable clamps stripping from the posts, it is important that this action proceed unhindered if possible. It was found that when the test collision vehicle progressed along the cable through a turnbuckle, the clamps and the contained mesh jammed at the turnbuckle. This resulted in an abrupt deceleration and violent "spin out" of the colliding vehicle.

No Effect On Deceleration

Two tests were made to judge the effect of repositioning chain link fabric outside the cables. This design eliminated binding while at the same time the removal of the chain link to the outside of the cable had no appreciable effect on the rate of deceleration of the car.

As was originally anticipated, the cable-chain link barrier on the Nimitz and Santa Ana test sections were subjected to a great deal of collision damage. The Maintenance Department found the most costly single item was the removal and replacement of the steel posts and their concrete footings. In addition to replacing the concrete and post, it was necessary for the posts to set in the new footings for at least 24 hours before the cable and chain link could be rehung on the post. This required two trips under heavy traffic conditions. It was decided that, if economically feasible, a post socket design or an otherwise modified footing could solve this problem.

Several designs were considered and all but two were eliminated for various reasons. For this selection two designs were developed and successively tested. One was a concrete collar around the upper one foot of the footing and the second a socket in a full depth footing. In the first the principle was that the earth below the collar would furnish support for the barrier while the collar was curing. Thus the barrier fabric and cable could be re-erected immediately.

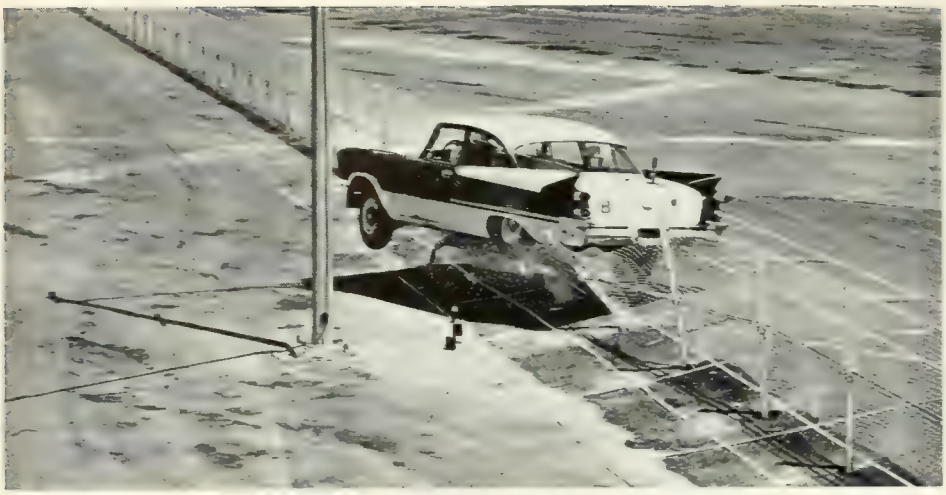
In two test collisions, the concrete collar type of footing was used and in five the socket type.

Collar Footing Adequate

The collar type of footing proved adequate. However, several of the



An accident on a freeway. This type of partial climb could have been the result of the left front wheel jumping from the berm or raising over the lower cable. Photo by Los Angeles Herald-Express.



In this test the barrier was placed at the bottom of a simulated median ditch with 6:1 side slopes. The car traveling 74 miles an hour up an eight percent superelevation from the far side jumped the cable barrier (see sketch below).

footings broke during collision. It was therefore necessary to remove the concrete piecemeal before backfilling the hole and redrilling for the new footing. While this design proved adequate, it is considered practical only for locations where the soil is fairly tight and free of rocks.

Several methods of holding the posts in the sockets were considered. Among these were the use of steel wedges, bolts, set screws, wood wedges, sand (plain and also topped with sulphur), sulphur, and asphalt. All were discarded in favor of asphalt.

However, it was considered necessary to determine the minimum restraint needed to keep the post in place during collision. Therefore tests first were made using an oversize socket with the posts held in place only with wooden wedges. In each of these two tests at least one post pulled out.

Analysis of the data films indicates that during the early part of a collision, the posts are subjected to a substantial vertical force. Sufficient resistance must be offered to prevent uplift of the posts during this period of vertical loading.

These two tests proved that wooden wedges alone provided insufficient resistance. Therefore since sand has little or no internal resistance, it also was discarded. Steel wedges, through-bolt or set screws, could be made to work but were discarded because of cost and possibility of jamming. Sulphur would also work but was discarded because of potential corrision in addition to the difficulty of cleanout or reheating of the sulphur during repair.

Sockets Filled With Asphalt

After completing tests using wooden wedges alone, the sockets were filled with asphalt which proved to be adequate. The Grade 200-300 paving asphalt that was chosen proved able to resist the shock loading with no movement. At the same time the damaged post could be removed by a slow pull and a new post placed by slow pressure. In a controlled laboratory test, it was found that a pull of 700 pounds was necessary to remove a post from an asphalt filled socket when tested at 0°F. It took one minute to complete the removal.

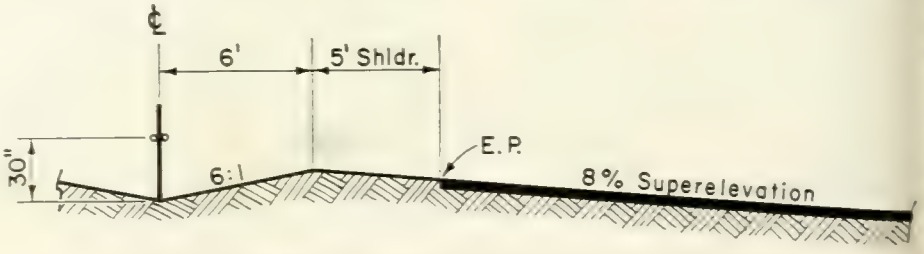
Of particular interest were tests to consider the effect of roadway slopes. For these tests a cross-section of highway found on many California freeways was simulated in which an 8 percent superelevation intersected a 6:1 sloped center drainage ditch. Actual barrier installations have been placed in the center of the ditch which is coincident with the center line of the freeway median area, with the thought that the cars on a collision course would follow the 6:1 side slope down to the barrier.

The tests showed that when the barrier was placed six feet away from the edge of the shoulder at the bottom of the simulated ditch, the car traveling at a 20° angle of collision would pass on over the barrier. After a study of the car's trajectory this was remedied in a following test by duplicating the previous test conditions but moving the barrier up the slope of the ditch to within one foot of the edge of the simulated shoulder, thus giving the car an opportunity to penetrate the barrier and become engaged under the cable.

Trajectory Analysis

Analysis of the trajectory of the car from the moving pictures indicates that a barrier, to be effective, should be placed no lower than 27 inches above the horizontal projection from the top edge of an approaching 8 percent grade. This is about the maximum superelevation that will be encountered in roads which justify the use of median barriers. The best solution for this condition is to place the barrier on the shoulder at the top or before the top of the superelevation. If it is necessary to place the barrier on the ditch side of the cross-slope, then the barrier cable should be no lower than 27 inches above the crown nor higher than 33 inches above the ground surface.

One test was made utilizing expanded steel mesh in lieu of chain link fabric. No difference in barrier action was noted. However, first cost and maintenance costs of the expanded fabric will be markedly higher than for the chain link fabric. This is due



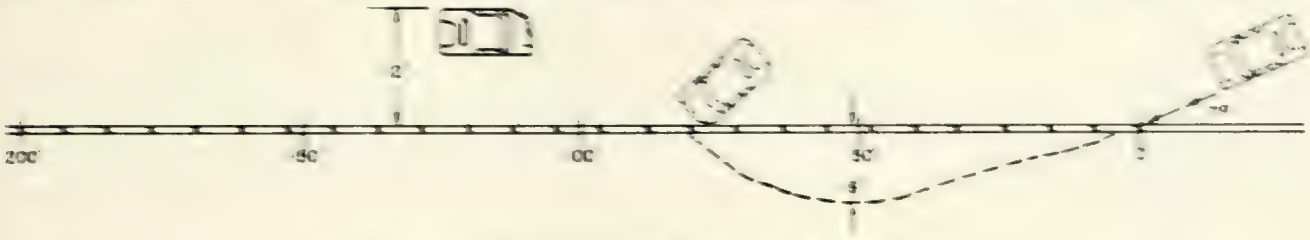
A cross-section diagram of the simulated median ditch shown in the above photo.











A typical test data sheet showing the result of Test No. 3 at a speed of time.

FENCE	42" 13 ga. steel expanded metal 1.33" x 3" diamond at 15" above pave.	FENCE DAMAGE	136' expanded metal damaged	TEST NO.	3
CABLE	¾" 6 x 19 WRC 2 at 30" above pavement	CABLE FITTING DAMAGE	none	DATE	7-24-61
POST FOOTING	Design 2	CABLE DAMAGE	none	VEHICLE	Dodge 58 Sedan
POST SPACING	8' C.C.	POST DAMAGE	16 damaged, 1 pulled out	SPEED	75 MPH
LENGTH OF INSTALLATION	600'	POST FOOTING DAMAGE	15 cracked, 1 failed	IMPACT ANGLE	7 degrees
GROUND CONDITION	Dry	MAXIMUM DYNAMIC DEFLECTION OF CABLES	6'	VEHICLE WEIGHT	4,300 lbs.
		VEHICLE DECELERATION (PEAK LONG)	5.7 g	W (CURB) AND INSTRUMENTATION)	
		VEHICLE DAMAGE	$350		

primarily to the higher first cost of the expanded metal but will also be affected by the fact that this material is furnished at present only in short panels.

In two tests ¾ x ¾ highway guard cable was substituted for the ¾ x 19 WRC cable usually used. This ¾ x ¾ cable was more difficult to handle during repairs and placement. In addition its cross-section did not lend itself to proper adjustment during the tightening of the cable to post clamps. In general, these tests seemed to indicate that the cross-section and relative stiffness of the ¾ x ¾ cable to the ¾ x 19 cable make the latter cable more desirable for use as a flexible barrier member.

PROCEDURE AND INSTRUMENTATION

With the exception of the type of the cars and speed and angle of approach, this series of tests was conducted in the same manner as the full scale tests reported in 1961.

So as to more nearly simulate the type of accident that seemed to cause problems with the cable barrier, heavier cars over 4,000 pounds driven at higher speeds (over 60 m.p.h.) and colliding at flatter angles (15° or less) were used.

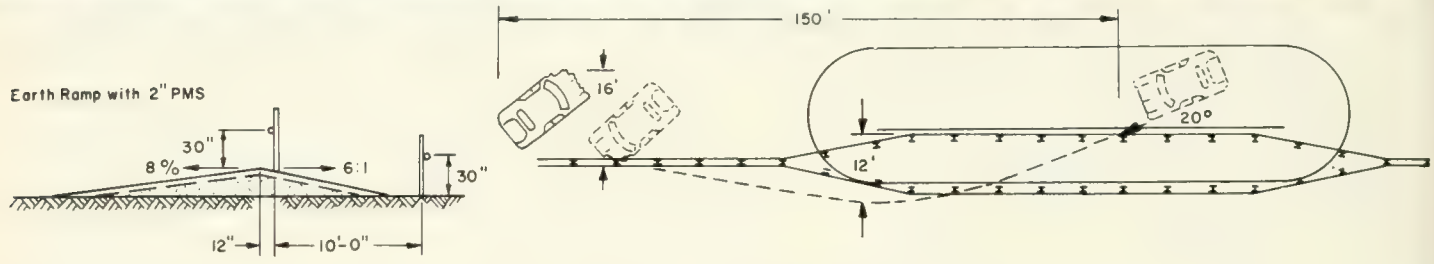
Since this series of tests were designed to test refinements of design rather than the overall effectiveness of the barriers, the instrumentation was not as complete as that previously used. Decelerations were determined from an analysis of the high speed data films rather than from decelerometers mounted in the vehicle and the dummy.

The anthropometric dummy was unrestrained, and its movements through collision were observed by a high speed data camera mounted inside the vehicle.

The photographic instrumentation was approximately as used previously, except that the following cameras were used rather than those listed in the previous test. The below listed 16 mm data cameras gave 100 percent reliability rather than the 25 to 50 percent reliability obtained in the past.

Camera Number	Type	Frame Rate	Lens	Location
1	Fastax	1,200	12.5mm	100 feet behind barrier
2	Photosonics	400	12.5mm	Tower covering pre-impact
3	Photosonics	400	12.5mm	Tower covering impact
4	Photosonics	400	12.5mm	Tower covering post impact
5	Photosonics	400	4 in.	Rear ground mount
6	Photosonics	400	4 in.	Front ground mount
7	Photosonics	400	12.5mm	In crash vehicle
8	Photosonics	400	1 in.	Rear platform





Test data sheet of Test No. 9 showing action through an envelope design.

FENCE	48" chain link at 9" above pavt.	FENCE DAMAGE	136' damaged
CABLE	¾" 6 x 19 IWRC 2 at 30" above pavement	CABLE FITTING DAMAGE	none
POST FOOTING	Design B	CABLE DAMAGE	none
POST SPACING	8' O.C.	POST DAMAGE	22 damaged—11 slightly bent
LENGTH OF INSTALLATION	400'	POST FOOTING DAMAGE	7 anchors cracked
GROUND CONDITION	Dry	MAXIMUM DYNAMIC DEFLECTION OF CABLES	12'
		VEHICLE DAMAGE	$750

TEST NO.	9
DATE	9-29-61
VEHICLE	Dodge 59 Sedan
SPEED	82 MPH
IMPACT ANGLE	20 degrees
VEHICLE WEIGHT (W/DUMMY AND INSTRUMENTATION)	4,300 lbs.

In addition to the 16mm cameras, one Bolex and one Bell & Howell 24 frames/sec. cameras were placed at various locations for documentary coverage. All sequence pictures shown in the exhibits were recorded with a 70mm Hulcher Mod. 20 camera at a 20 frames/sec. rate.

AASHO ROAD TESTS TO BE DISCUSSED

A three-day conference to discuss the findings of the $27 million AASHO Road Test will be held May 16-18 at the Sheraton-Jefferson Hotel, St. Louis, Missouri.

The road test was a five-year project aimed at determining the effect of various vehicle loads on highway pavements of various design of special interest to highway designers, materials producers, truckers, and motorists. Results are expected to have great influence on future pavement design and to provide some of the information needed by those charged with equitable taxation of highway users. The conference will be sponsored by the Highway Research Board, a unit of the National Academy of Sciences—National Research Council. Papers to be presented at the conference will cover the results of pavement and bridge research findings.

"These meetings will be open to anyone who is interested in highway research," R. R. Bartelsmeyer, Chief Engineer, Illinois Division of Highways, and Chairman of HRB, announced. "We will make provisions in the program, also, to permit free discussion of the papers."

The Highway Research Board administered and directed the huge project which was sponsored by the American Association of State Highway Officials (AASHO). The project was financed by 49 states, District of Columbia, Puerto Rico, U. S. Bureau of Public Roads, Automobile Manufacturers Association, American Petroleum Institute, and American Institute of Steel Construction, with the co-operation of the Department of Defense.

A series of reports on the AASHO Road Test are scheduled for publication prior to the St. Louis conference and will be available at nominal cost from the board, 2101 Constitution Avenue, Washington 25, D.C.

ORANGE COUNTY COLLEGE

The Division of Architecture has advertised for contracts on boiler and refrigeration equipment for the Science and Classroom Building at Orange County State College which is estimated to cost approximately $570,000. The Science and Classroom Building itself is presently under construction and constitutes a $9,400,000 project. Ultimate occupancy of the building is scheduled for September 1963.

Fewer Accidents

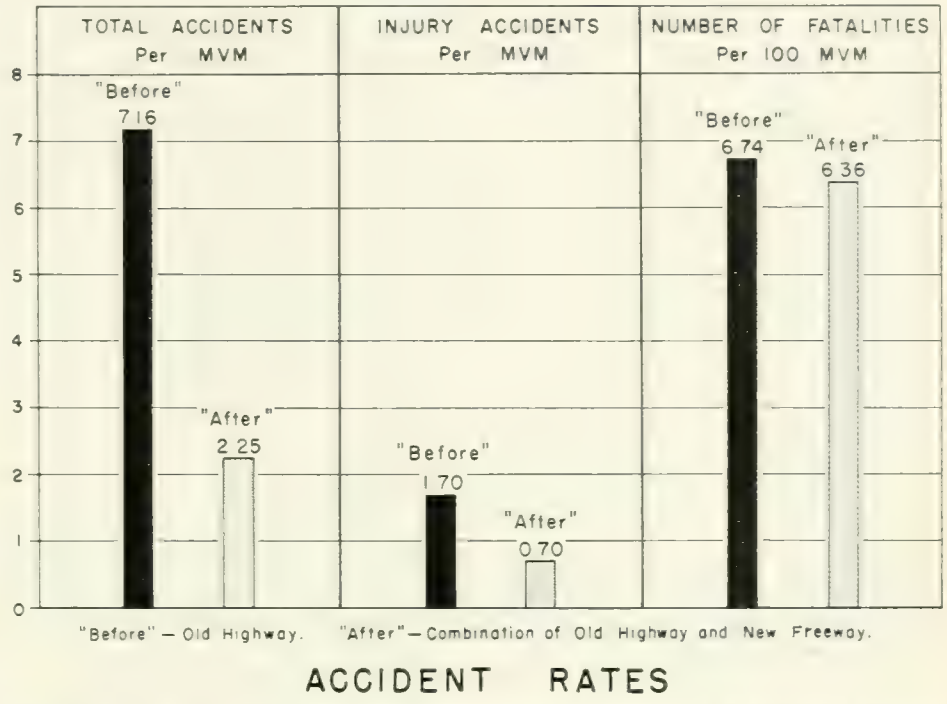
Richmond-Carquinez US 40 Study Shows Three-Year Drop

By GLEN E. DILLON, District Traffic Engineer



A recent study by the Traffic Department of the Division of Highways San Francisco Office revealed that the number of accidents on US 40 between Richmond and Carquinez was reduced from 921 per year to 103 per year when the old highway was superseded by a freeway.

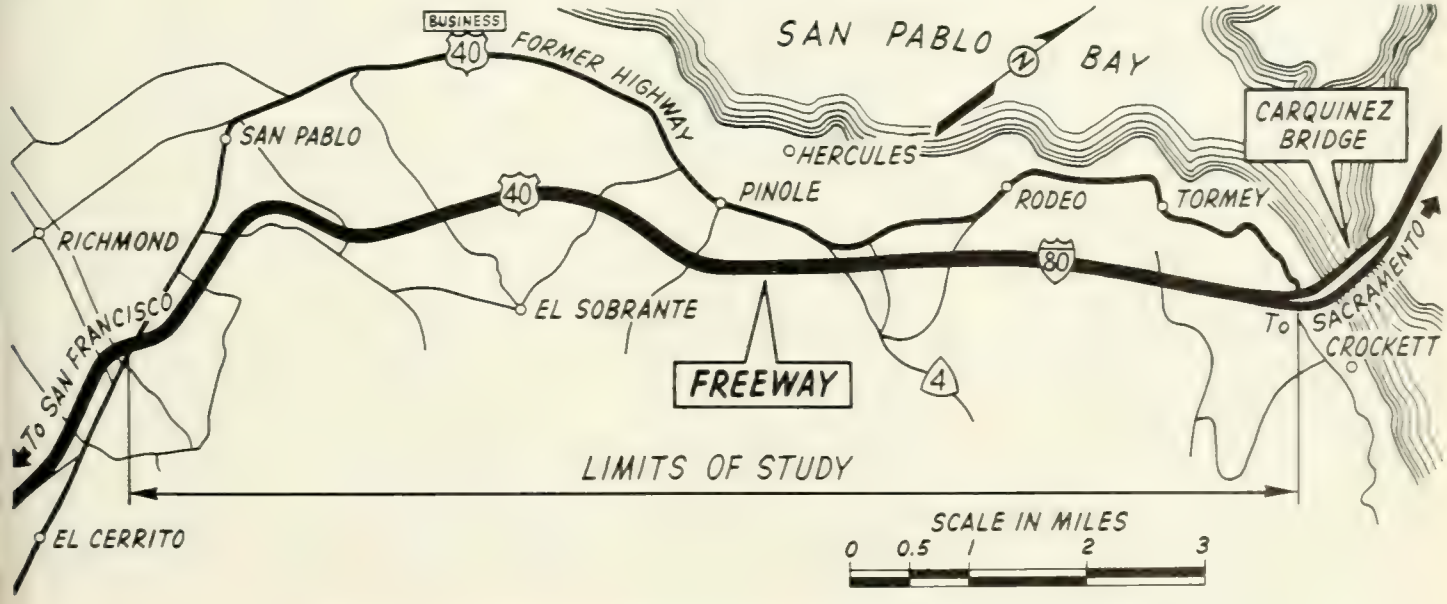
Comparing a three-year period (1954-56) before construction began with a three-year period after construction was completed, traffic on US 40 increased from 27,000 to 36,000 vehicles per day. Accidents decreased from 2,763 in three years on the old road, to 309 in three years on the new freeway. In other words, traffic increased by one-third and accidents were reduced nine-tenths. Had the old accident rate remained constant with the increased amount of traffic, 3,400 more accidents *would* have occurred than *did* occur during the first three years of the freeway's operation.



Accident rates before and after the opening of the freeway are compared in the above bar chart. MVM means million vehicle miles.

Freeway Opened in 1958

The 6-lane 10½-mile freeway (now designated Interstate Route 80 as well as US 40) from San Pablo Avenue in Richmond to the Carquinez Bridge was completed under progressive contracts and opened for its full length to traffic on November 25, 1958. The



The traffic study described in this article covered the section of US 40 shown in the above map.

TABLE 1

COMPARISON OF ACCIDENTS ON U.S. 40 BETWEEN SAN PABLO AVENUE IN RICHMOND AND CARQUINEZ BRIDGE

Three Years Before and Three Years After Construction of Freeway

	Before	After		
	Old highway	Old highway	Freeway	Old highway and freeway
Distance, miles	13.00		10.53	
Travel time, minutes (approximate)	27		11	
Average daily traffic	27,000	8,700	35,900	44,600
Million vehicle-miles	385	125	410	535
Number of accidents:				
Total	2,763	897	309	1,206
Injury	654	240	137	377
Number killed	26	11	23	34
Accident rates:				
Total, per million vehicle-miles	7.16	7.20	0.75	2.25
Injury, per million vehicle-miles	1.70	1.93	0.33	0.70
Fatalities per 100 million vehicle-miles	6.74	8.83	5.60	6.36

TABLE 2

REDUCTION IN ACCIDENTS, BOTH ROADS COMBINED

(After) vs. Old Road (Before)

	Reduction in Number of Accidents	Reduction in Accident Rate
May-June 1958 p. 31 Sacramento-Roseville Freeway	48%	66%
May-June 1959 p. 2 Fresno Freeway	54%	66%
January-February 1960 p. 60 Madera Freeway	69%	72%
July-August 1961 p. 25 Vallejo Freeway	73%	78%
(This study—Richmond to Carquinez)	(56%)	(69%)

new facility provided badly needed relief for the overloaded four-lane conventional highway through the cities of Richmond, San Pablo, Pinole, Hercules, and Rodeo and the community of Tormey. The accompanying map shows the general layout of the freeway.

The accidents were tabulated for the three years 1954, 1955, 1956 of the "before" condition, prior to opening the first section of freeway as far as County Road 20. These were compared with the "after" condition on the new freeway for the three years after its opening in November 1958.

A comparison was also made between the record of the old road when it was carrying all the traffic and that of the combination of the old road and new road after the through traffic was diverted to the freeway.

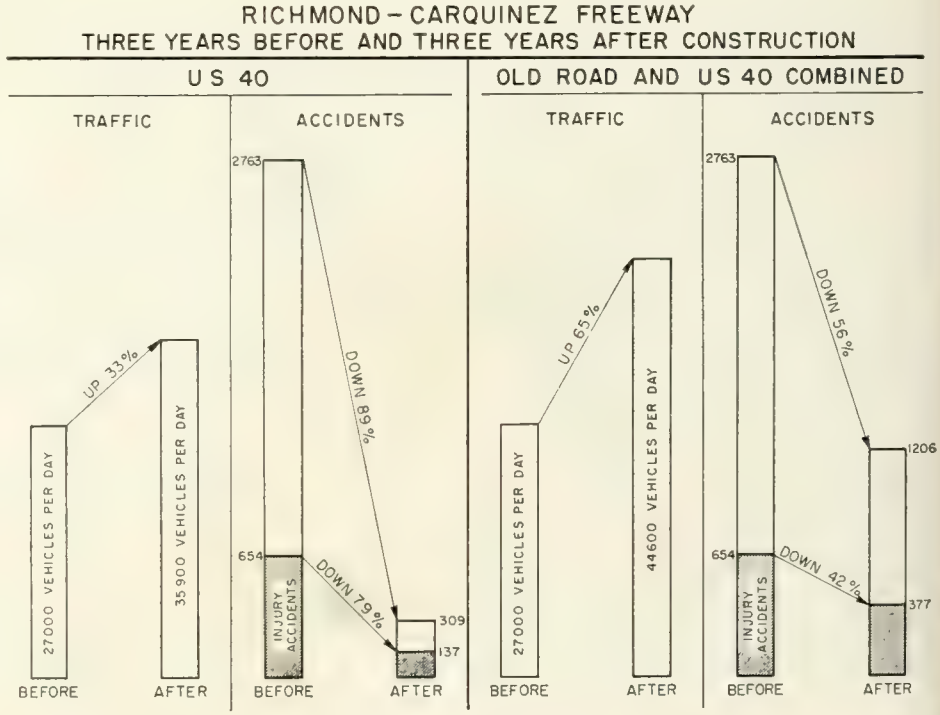
In the three-year "before" period the old road served an average of 27,000 vehicles per day and experienced 2,763 accidents. In the three-year "after" period, the old road served 8,700 vehicles per day and experienced 897 accidents. As shown in Table 1, the actual rate per million vehicle-miles stayed about the same.

Total Travel Increases

When the experience on the old road is combined with that on the freeway, it is found that total travel on both roads increased from 385 million vehicle-miles to 535 million vehicle-miles, or 39 percent,* while accidents decreased from 2,763 to 1,206 or 56 percent.

In relation to the amount of travel on both roads, the reduction was from 7.16 to 2.25 per million vehicle-miles, or 69 percent. While this is a heartening reduction, it is seen that the amount of travel remaining on the old road is still generating plenty of accidents, and the reduction would have been greater if travel on the old road could be reduced still more. This is one of the reasons why the Division of Highways endeavors to locate freeways so that they will attract the most possible traffic from conventional roads. In order to do this it is usually necessary to locate them near traffic-generating land uses instead of as far as possible from traffic generators and existing highways.

* Although *traffic* increased 65 percent, the new route is so much shorter than the old route that *travel* increased only 39 percent.





Motorists now enjoy the use of US 40 (Interstate 80) through the City of Richmond. The old route (San Pablo Avenue) on the left has been relinquished to the city.



ooking north from San Pablo Undercrossing in Richmond, showing the modern interstate facility which replaced the old route with its many signalized intersections (left..

Similar Studies

Similar studies which have appeared in *California Highways and Public Works* with the corresponding reduction in number of accidents and in rate of accidents are shown in Table 2.

This shows how consistently and dramatically the accident picture is improved when freeways are constructed to relieve heavily traveled conventional at-grade highways.

In view of the striking overall improvement, it is discouraging to note that the fatality rate on the new freeway is still 5.6 per hundred million vehicle-miles, which is about double the average for freeways and only 17 percent less than the old US 40. The 13 fatal accidents in three years, causing 23 fatalities, have been examined in some detail. As usual, a high proportion, 6 out of 13, involved drinking drivers. Two of the 13 were pedestrians who were on the freeway illegally, and five were single-car accidents that simply drove off of the highway which (including shoulders) is 46 feet wide on each side of the median strip. Four of the 13 fatal accidents occurred between 1 a.m. and 5 a.m., although less than one-tenth of the travel occurred during those hours. This fact is also characteristic of fatal accidents on freeways.

Fortunately, the rate during the past two years (3 fatal accidents in each of 1960 and 1961) is much improved over what it was during the first 12 months, when seven fatal accidents occurred, including two head-on, cross-median collisions. Funds for construction of a median barrier on the southern end where traffic is very heavy are included in the current State Highway budget.

LOOP SECTION OPENED

A major section of the Los Angeles freeway system was opened to travel Friday, March 30, following appropriate ceremonies marking the completion of the Golden State-Santa Monica Freeway Loop as far west as the Harbor Freeway. The new $9,360,000 link extends along the Santa Monica Freeway from Main to Oak Streets, including the interchange with the Harbor Freeway.

Sign Changes

Revised Interstate Manual Will Be Published Soon

By GEORGE M. WEBB, Traffic Engineer

Freeway signing in California is in basic conformance with the requirements for signing the interstate system in order to provide a uniform type of signing on all California freeways.

The original Manual for Signing of the National System of Interstate and Defense Highways was issued in 1958. The signing in this manual generally conforms to that used on the eastern toll roads.

Need for Changes

In the application of the 1958 manual, the need for changes and interpretations became apparent, primarily to make signing applicable to metropolitan areas with closer-spaced interchanges.

The AASHO Committee on Traffic established a subcommittee to review suggested sign manual changes and the AASHO established a special committee on signing and marking interstate system to interpret provisions of the interstate manual.

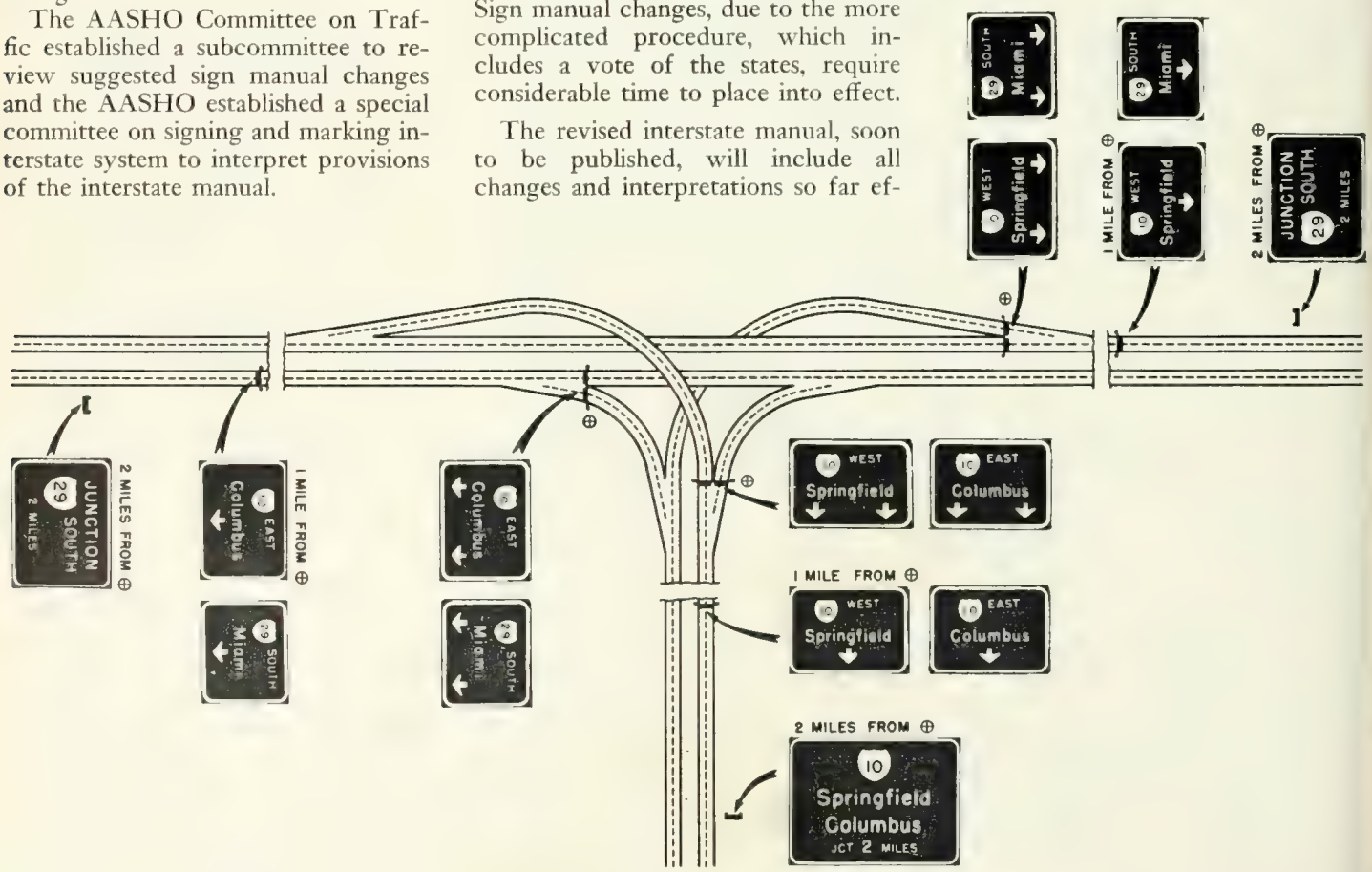


The sign used in metropolitan areas to indicate the next three exits and the distances thereto has also been adopted for similar use on the Interstate system.

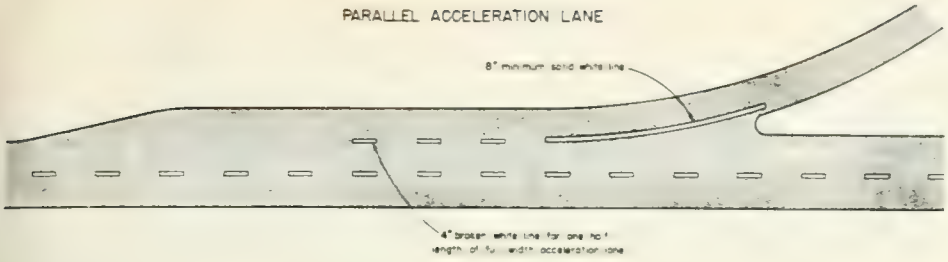
States Are Informed

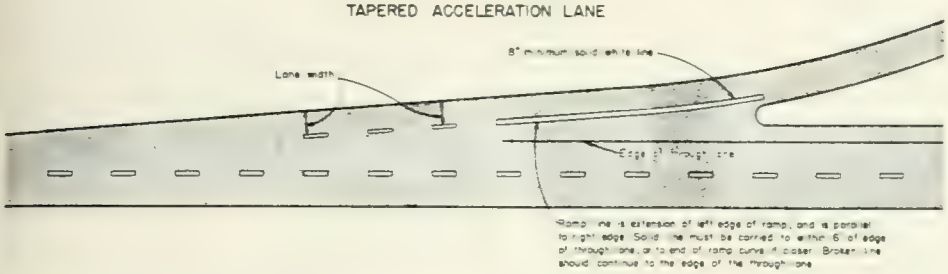
Such interpretations, if concurred in by the Federal Highway Administrator, are promptly issued to various states by the Bureau of Public Roads. Sign manual changes, due to the more complicated procedure, which includes a vote of the states, require considerable time to place into effect.

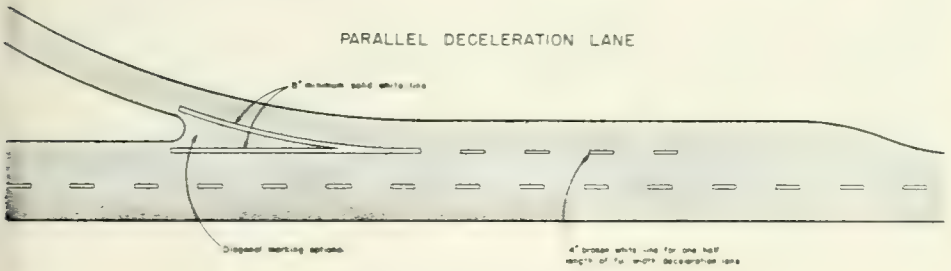
The revised interstate manual, soon to be published, will include all changes and interpretations so far effected. Illustrations used in this presentation are reproductions of plates which will appear in the forthcoming manual.

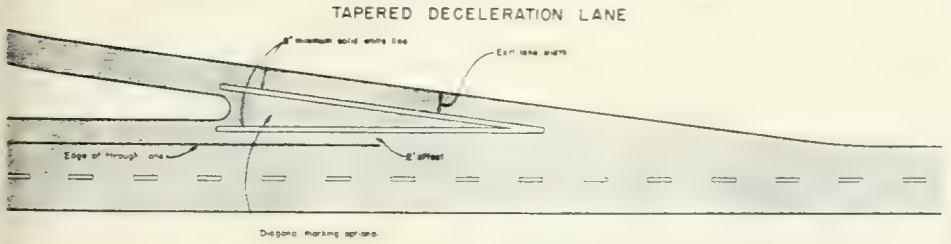


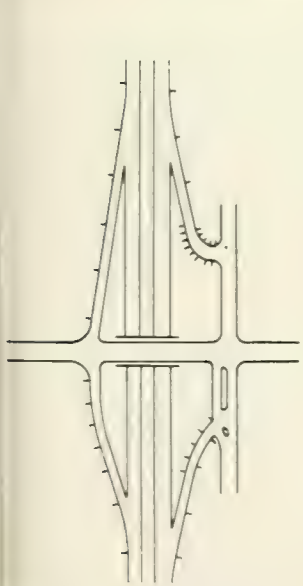
The use of "JCT ONE MILE" instead of "EXIT 1 MILE" on advanced signs when approaching a major freeway junction has now national approval. Signs in the above diagram also illustrate the new requirement that all shields used on guide signs should be displayed in their standard colors, which means that U.S. and state shields will be white with black numerals.

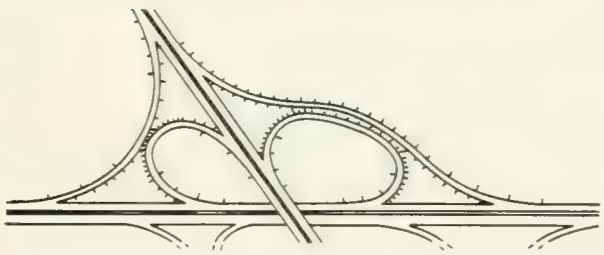


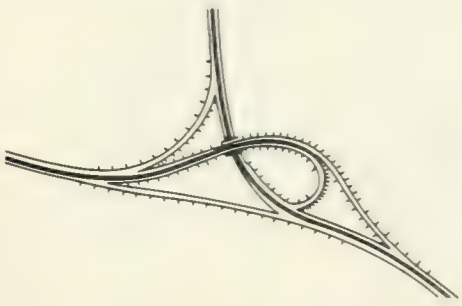












Other interstate adoptions which comply to California standards include the standard striping at entrance and exit ramps and the use of delineators on the outside ramp curves.



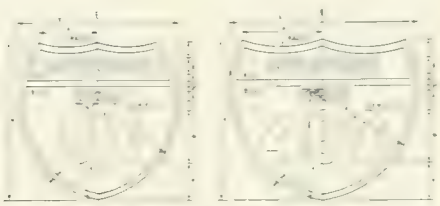
"NEXT EXIT" as used on a sign to show additional destinations at an interchange was revised to read "NEXT RIGHT" or "NEXT LEFT." The additional wordings "SECOND RIGHT" or "SECOND LEFT" are provided to indicate other destinations or services at the second ramp of a cloverleaf interchange.



All shields on guide signs will appear in their standard colors. This means that U.S. and state shields will be white with black numerals.



The "RIGHT LANE" sign has been adopted for use on the interstate system, but alphabet size has been increased for major or intermediate interchanges.



Another new look will be the widened interstate shield to accommodate three digits. California, with U.S. Bureau of Public Roads approval, has used a widened shield on overhead signs but the new change will provide a wider shield for independent post mounting.

Traffic Safety

Governor's Conference Draws 1,200 Delegates

When more than 1,200 delegates, representing a cross section of California's population, assembled for Governor Edmund G. Brown's Traffic Safety Conference in Los Angeles on February 1 and 2 they were treated to a new concept in conference deliberations.

For the first time delegates, whether traffic safety experts or interested individual citizens, were given the opportunity to present their ideas, to advance new theories, or to criticize existing techniques—all in the interest of reducing accidents on the streets and highways of the State.

In keynoting the conference, the Governor stressed that while progress is being achieved toward greater highway safety there is no room for complacency when people are being killed and maimed in traffic accidents.

He cited recent accomplishments in California, including more stringent legislation against the drinking driver; the requirement that all new vehicles sold in the State after January 1, 1962, must be equipped with seat belt mountings; and the broadened research program now underway.



Governor Brown delivers keynote address to the 1,200 delegates gathered from all over the State for the safety conference. Seated is Benjamin H. Swig, Conference General Chairman and member of the President's Committee for Traffic Safety.



A billboard safety message is inspected by Robert B. Bradford, State Transportation Agency Administrator; Major General Perry B. Griffith, Deputy Inspector General for Safety, U.S. Air Force; State Senator Benjamin J. Arnold, Sr., of Arizona, and Mrs. Ruth Kodani, Los Angeles. Arnold and Mrs. Kodani are members of the President's Committee for Traffic Safety.

Fine Co-operation Praised

Praising the fine co-operation of the departments in the new Highway Transportation Agency in efforts to advance traffic safety through unified action, the Governor expressed optimism for the eventual success of present research.

The Governor also announced a $175,000 grant from the Federal Department of Health, Education and Welfare, for research to show how well a driver really sees from a moving vehicle. It is hoped that the new program, being conducted co-operatively by the University of California's Institute of Transportation and Traffic Engineering and the Department of Motor Vehicles, will establish relationships between certain vision test scores and driving records of applicants for driver licenses.

Urges Graphic Means

Governor Brown also called on the Highway Transportation Agency to develop graphic means of retraining motorists in safe freeway driving methods. He urged instruction on

proper ways of entering and leaving freeways, proper signalling and lane changing, use of rear view mirrors, and the need for motorists to be alert to developing traffic situations far in advance of their own vehicles.

Other actions urged by the Governor included expansion of behind-the-wheel training in high schools, and the establishment of more schools for traffic law violators.

The conference also featured a call for action by Benjamin H. Swig, conference general chairman and member of the President's Committee for Traffic Safety. Swig urged delegates to work toward a meeting of all Governors to support enactment of uniform vehicle laws. He acknowledged the importance of state and local control in traffic safety endeavors, but warned that without more vigorous action there remains the distinct possibility of the federal government being forced to enter the accident prevention program.

Hearst Is Chairman

These same points were reiterated by William R. Hearst, Jr., in his remarks at the luncheon concluding the conference. Hearst, editor-in-chief of the Hearst newspapers, is chairman of the President's committee. Hearst called for an aggressive action program.

One of the features of the 1962 Governor's Conference was the inclusion, for the first time, of a Women's Activities Division, chaired by Beth Bennett, Deputy Director, California Department of Motor Vehicles. Tom M. Bright, Director of Motor Vehicles, served as conference co-ordinator, and Robert B. Bradford, Administrator of the Highway Transportation Agency and Director of Public Works, summarized the need for support of the 1962 Action Program during the conference windup luncheon.

The California Traffic Safety Foundation and the California Federation of Safety Councils served as co-sponsors of the conference, co-operating with the official agencies of state government.

After approval by the various division chairmen, a priority list of items for the Action Program will be distributed by the foundation.

F.A.S. CHIEF LaFORGE RETIRES; BEER NAMED

Harold B. LaForge, engineer in charge of Federal Secondary roads and state-county partnership in road matters for the past 17 years, retired from state service on May 1. He has had 42 years of service with the State Division of Highways beginning shortly after his return from World War I overseas duty in 1919.

Charles G. Beer, assistant district engineer for the Division of Highways at San Bernardino, will succeed LaForge.

The Federal Aid Secondary program which LaForge has administered for the Division of Highways since 1945 has involved an estimated $220,000,000 to date in construction contracts on about 3,500 miles of county roads and 500 new bridges in all parts of the State.


HAROLD B. LaFORGE

LaForge, who is widely known among county officials throughout California through his long identification with the F.A.S. program, was born in Wadsworth, Nevada, but moved to Sacramento as a child and was educated in Sacramento.

In World War I he served overseas with the 311th Engineers. On his return, he went to work for the Division of Highways on survey crews, first in the Central Valleys and later in the Central Coast area.

In 1926 he moved to the Fresno district, where he spent the next 11 years as resident engineer. He is credited with major innovations in methods of placing asphaltic concrete pavement.

From 1937 to 1942 LaForge served as district maintenance engineer in the Redding district, and then moved to Division Headquarters in Sacramento as assistant office engineer in charge of War Production Board contracts.

He was placed in charge of the Federal Aid Secondary road program in June 1945. His work in this position was summed up in 1960 by R. P. O'Neill of Butte County, then president of the County Engineers Association of California.

"Red LaForge has undoubtedly done more to raise the standards of our county road administration, engineering and personnel than any other single individual."

LaForge is a member of the American Society of Civil Engineers. He and his wife, Marjory, plan to move to Auburn. They have two daughters, Mrs. Ann Parker of Pleasant Hill, and Mrs. Jane Ohmer of Oroville, and seven grandchildren.

His successor as engineer of Federal Secondary roads, Beer, has been on the Division of Highways staff for 26 years and has been assistant district engineer in charge of administration for District VIII, with headquarters in San Bernardino, since 1955.

Beer was born and educated in Los Angeles and received his bachelor's degree in civil engineering at the University of California at Berkeley in 1940. He received a master's degree in meteorology in 1945 at the University of California at Los Angeles, during World War II served as an Air Force meteorologist.


CHARLES G. BEER

He entered state service full time in 1936 in the Fresno district. He left in 1942 for four years of military service, and on his return specialized for the next four years in bridge engineering, mainly in Southern California.

From 1950 to 1955 Beer was assistant traffic engineer for the Los Angeles district, and then was promoted to assistant district engineer in San Bernardino.

He is a member of the American Society of Civil Engineers and the American Meteorological Society. He and his wife, Lucille, have three children.

Onion Valley

Inyo County's New F.A.S. Road Opens High Sierra to Motorists

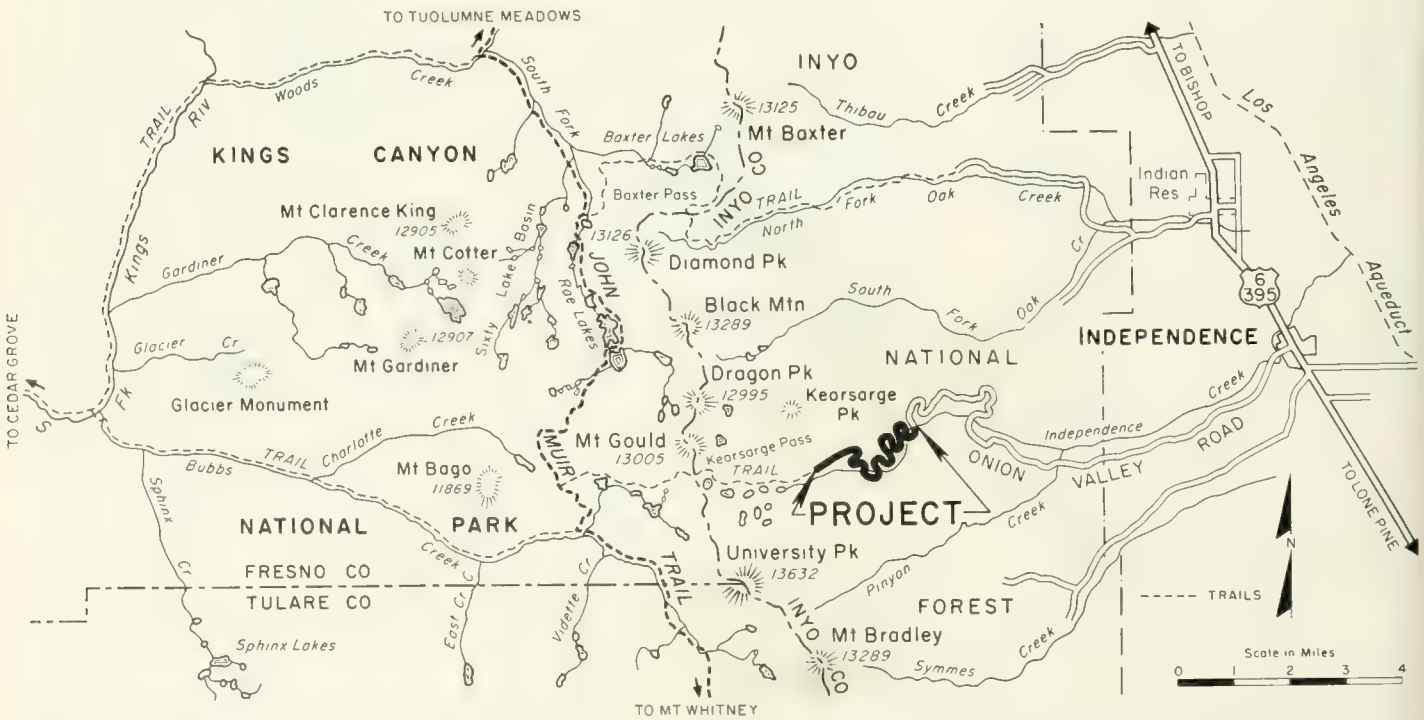
By R. D. BOTTORFF, Resident Engineer, Inyo County Road Department



There are few mountains that are more rugged than those of the eastern slopes of the High Sierra in Inyo County, California. Lying west of historic Independence, the county seat, is Onion Valley at an elevation of 9,200 feet above sea level and at the edge of a primitive area. From Onion Valley over Kearsarge Pass at elevation 11,800, pack trains and hikers have access to the Kings Canyon and Sequoia National Parks and unlimited back country. Kearsarge Pass is one of the most heavily traveled in the Sierras. The immediate vicinity of Onion Valley offers many areas of recreation: hunting, fishing, camping, mountain climbing and potential winter skiing.



Construction equipment is silhouetted against the dust raised by grading operations on the Onion Valley F.A.S. Route 1183 project in Inyo County.



The Onion Valley Road, as indicated in the above map, will give access to a High Sierra primitive area traversed by the famous John Muir Trail. Inyo County has spent or pledged Federal Aid Secondary Funds during five fiscal years since 1955 toward the improvement of this route.

In order to reach the pack station at Onion Valley, recreation seekers have had to drive from U.S. Routes 395 and 6 in Independence over a narrow, winding, rough, dusty road having 17 switchbacks within the upper 5 of its 15 miles and grades with a rise of 18 feet per hundred feet of travel.

Plans for Upper Portion

Having improved the lower 8.5 miles of the Onion Valley Road to modern standards by 1956, Inyo County officials began immediately to plan for improvement of the upper portion so as to provide better access to recreation areas needed by California's rapidly growing population. The board of supervisors requested the extension of federal-aid secondary route 1183 to Onion Valley in order that federal-aid and matching state highway funds available to the county could be used to finance construction projects thereon. With this extension, FAS Route 1183 became the longest of five county FAS routes that penetrate the Sierra.

The first construction on the extension was a grading and drainage contract awarded in June 1960 and now nearing completion. Recently advertised is a contract for placing base rock and road-mixed asphaltic surfacing on the same 5.4 miles. Although contracts under California's federal-aid secondary highway program are awarded by the State Department of Public Works, the projects are designed by and construction is supervised by county personnel.

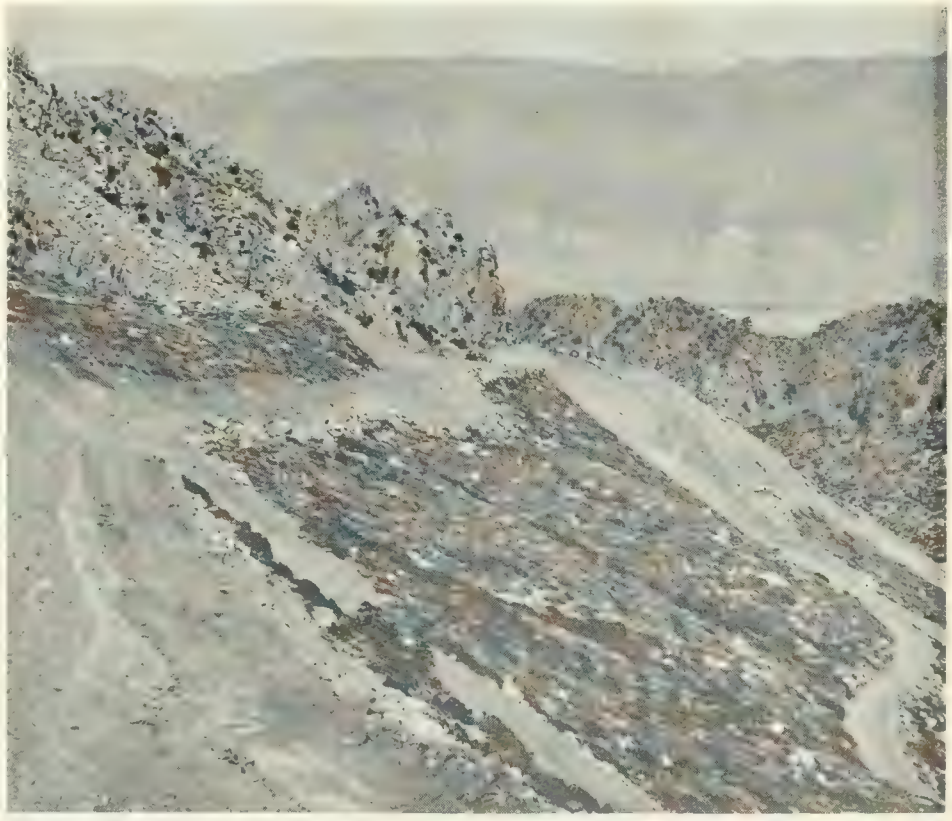
Saves 1½ Miles

The new alignment is located and limited to the southern exposure of Kearsarge Mountain with a ruling grade of 8 percent, and saves 1½ miles of travel, requiring only nine switchbacks. Through cuts are daylighted or flattened to a 10-on-1 slope on the exposed side to facilitate snow removal and melting. The roadway width when completed will be 28 feet minimum with 22 feet of surfacing.

Construction of the project has presented the contractor with many problems, traffic being one of major importance. The new alignment diagonally crosses the old road at many locations completely obliterating the



A view of F.A.S. Highway 1183 looking toward its western terminus in Onion Valley at the foot of the Kearsarge Pass Trail. Asphalt surfacing, not yet placed, has been delineated on the photo.



Looking eastward over rough grading operations on the Onion Valley Road project toward Owens Valley in the distance beyond Independence, County Seat of Inyo County.

existing traveled way. This required the programming of work so that temporary connections could be made between the two routes. Safety precautions were given prime consideration, particularly during pioneering, when boulders ranging from 6 inches to 12 feet in diameter could easily escape and go crashing down upon men and equipment below.

Some Drilling, Blasting

Only about 10 percent of the total 617,000 cubic yards of excavation required drilling and blasting. Much of the excavation was done with power shovels plus small (by present-day earthmoving standards) hauling units and scrapers. The use of larger equipment was restricted by the limited road width and many sliver cuts and fills typical of sidehill construction. Many embankments were constructed exclusively with bulldozers, there being as many as 19 on the job at one time.

Water was supplied to excavation and embankment areas by 30,000 feet of 2-, 3- and 4-inch diameter aluminum gravity flow pipeline system from Independence Creek. Dissipators were required in some locations to control allowable working pressures.

Engineering functions by county employees are under the general direction of Road Commissioner John K. Smith with on-the-job supervision of the writer. The grading work is being performed by R. A. Bianchi and R. A. Bianchi Construction Company.

WONDERS OF AMERICA

"The importance of California's freeway system—not to be confused with the toll ways of other states—is one of the wonders of America.

"In Southern Alameda County, the people no longer judge distance by miles, but by the clock. San Jose is no longer 'so far away' from San Leandro, but little more than half an hour leisurely driving away. San Francisco is in most cases, less than half an hour away. . . .

"The only problem of freeways that has not been solved is the man behind the wheel."—From an editorial in the *San Leandro Morning News.*

IN MEMORIAM

District III
Harry Disbro, Highway Equipment Operator-Laborer

District IV
Floyd W. Black, Highway Maintenance Man III
Jake G. Arfsten, Laborer
Donald L. Tice, Assistant Highway Engineer
Yvonne C. Holland, Intermediate Typist Clerk

District VI
Paul C. Tibbitts, Supervising Groundsman
Dwight Wonacott, Highway Superintendent
Maurice E. Trew, Highway Equipment Operator-Laborer

District VII
Lyman Weiderheft, Groundsman

District VIII
Harold O. Hodges, Groundsman

District X
James Keller, Engineering Aid I
Edward Lowe, Highway Engineering Technician I

District XI
James S. Gulley, Highway Equipment Operator-Laborer

State-owned Toll Bridges
Harry B. Davis, Stock Clerk

Materials and Research Department
James V. Leslie, Highway Engineering Technician I

Bridge Department
Martin C. Blair, Highway Engineering Technician I
John G. Gaillard, Assistant Bridge Engineer

TRAFFIC RELIEF IN L.A.

Opening to traffic of the Santa Monica-Golden State Freeway Loop offers major relief to the downtown Los Angeles area in providing an alternate bypass route skirting the Civic Center formerly served by the Hollywood Freeway alone.

Department Lists New 25-Year Awards

Headquarters Office
George Minisan

District I
Charles L. Pelascini

District II
Roy W. Poole
Charles W. Shults

District IV
Fred R. Melgar
Gladys V. Solvin

District VI
Clifford R. Donnelly
Paul M. Hine
Marie Frances Park

District VII
Peter M. Cowie

District VIII
C. J. Clanton

District IX
Dave E. McAllister

District X
Robert O. Stone

Bridge Department
William N. Hedgpeth

Materials and Research Department
Charles W. Clawson

Shop 4
Frank P. Erwin
Freeman L. Vacher

Shop 5
William R. Ramsay

Shop 6
Herbert L. Carroll

FREEWAY CONVERSION

The State Department of Public Works has awarded a $1,027,971 contract for constructing an interchange and frontage road to convert a section of US Highway 99 in Kern County from expressway to four-lane freeway standards between Laval Road south of Wheeler Ridge and State Sign Route 33-166 at Mettler.

Whiskey Creek

Two-lane Structure Built to Provide for Future Widening

By J. D. PETTINE, Associate Bridge Engineer



In January 1960, the relocation of five miles of State Highway US 299 between 2.5 miles east of Tower House and 2.5 miles east of Whiskeytown was made necessary by the U.S. Bureau of Reclamation's planned construction of Whiskeytown Dam. The project is located in Shasta County 11 miles west of Redding and provides a two-lane expressway with a 40-foot roadbed width. Whiskeytown Dam, currently under construction on Clear Creek two miles downstream from Whiskeytown, will inundate the townsite as well as the existing highway with a reservoir storing 250,000 acre feet of water. The reservoir is a portion of the Central Valley Project and serves as an intermediate step in diverting water from the Trinity River at Lewiston to the Sacramento River at Keswick.

Tributary to Clear Creek

Whiskey Creek is a tributary to Clear Creek and was the major control point in selecting the route for the highway relocation around the reservoir. The Whiskey Creek arm of the lake forms an opening that is spanned by an embankment 1,800 feet long and an 875-foot structure. The depth of water under the structure will be more then 160 feet. Construction of the bridge across Whiskey Creek was one of the major items of work on the project.

The bridge is a reinforced concrete deck on steel girders with a trussed cross bracing, consisting of three spans, having a total length of 874 feet, supported on round concrete column bents and concrete abutments with wingwalls on spread footings and steel piles. The completed deck width is 28 feet between wheel guards to accommodate two lanes of traffic and the substructure includes provisions for expansion to a four-lane facility in the future.

Structural Steel Girders

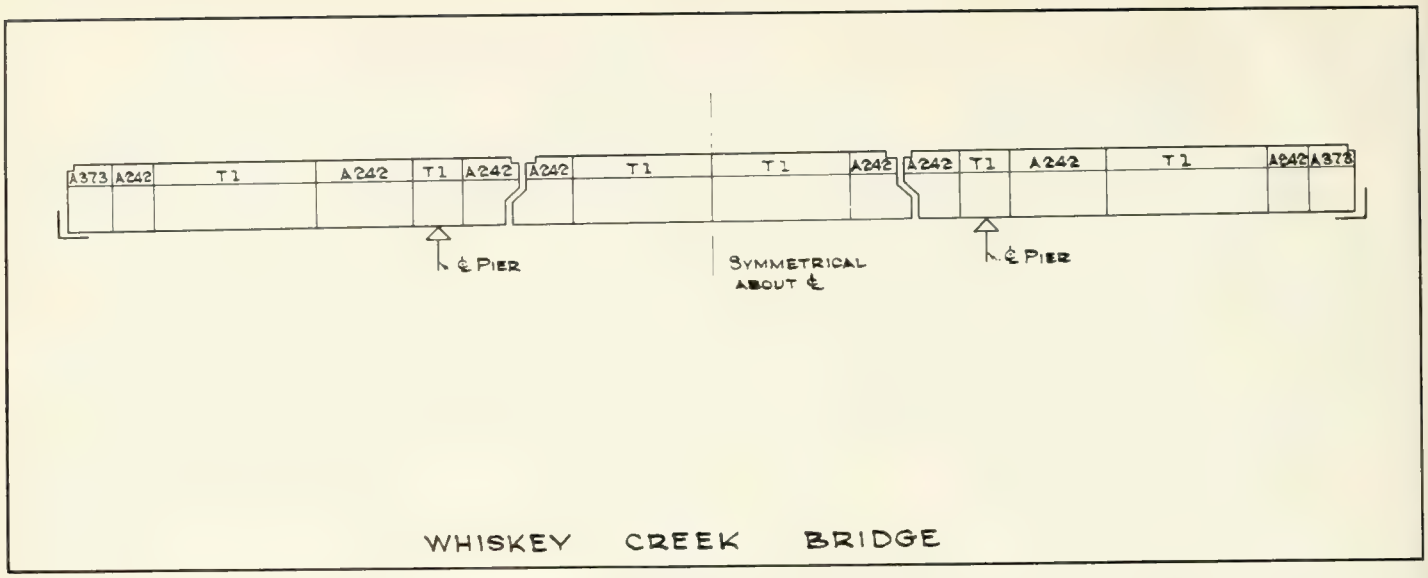
A combination of three types of steel were incorporated in the two main steel girders, portions of the plate girders subject to high bending moments were fabricated from "T-1" steel having a yield strength of 100,000 PSI, portion subject to moderate stress employed A242 steel, while that under lower bending moments used A373 structural carbon steel. Yield strengths of the latter steels are 50,000 PSI and 33,000 PSI respectively.

The accompanying drawing illustrates how these three types of steel were combined to most economically meet stress requirements while maintaining a uniform web depth and thickness and a uniform section of flange.

All structural steel was fabricated by United States Steel Company in Texas, and was shipped to Redding via rail. The 300-foot girders were shipped in lengths of 100 feet. All steel was then trucked to the jobsite for final assembly in the field. Structure work started on November 21, 1960. Considerable difficulty was encountered during excavation of pier footings due to slipouts at pier two and the necessity of drilling and blasting through 24 feet of solid rock at pier three. Pier footings were placed against undisturbed material and re-



The new Whiskey Creek Bridge on the relocated section of U.S. 299 between Redding and Weaverville. The view is westward.



The above drawing shows how three types of steel were combined to meet stress requirements most economically while maintaining a uniform web depth and thickness as well as a uniform section of flange.

quired approximately 800 cubic yards of concrete per footing.

Column Measurements

Pier columns are 16 feet in diameter for one-half their heights or 70 feet and 12 feet from there to the pier cap. Each column contained from 72 to 96 2¼-inch reinforcing steel bars, weighing 13.6 pounds per foot. All bar steel was trucked to the job site full length so that weld splicers would not be required.

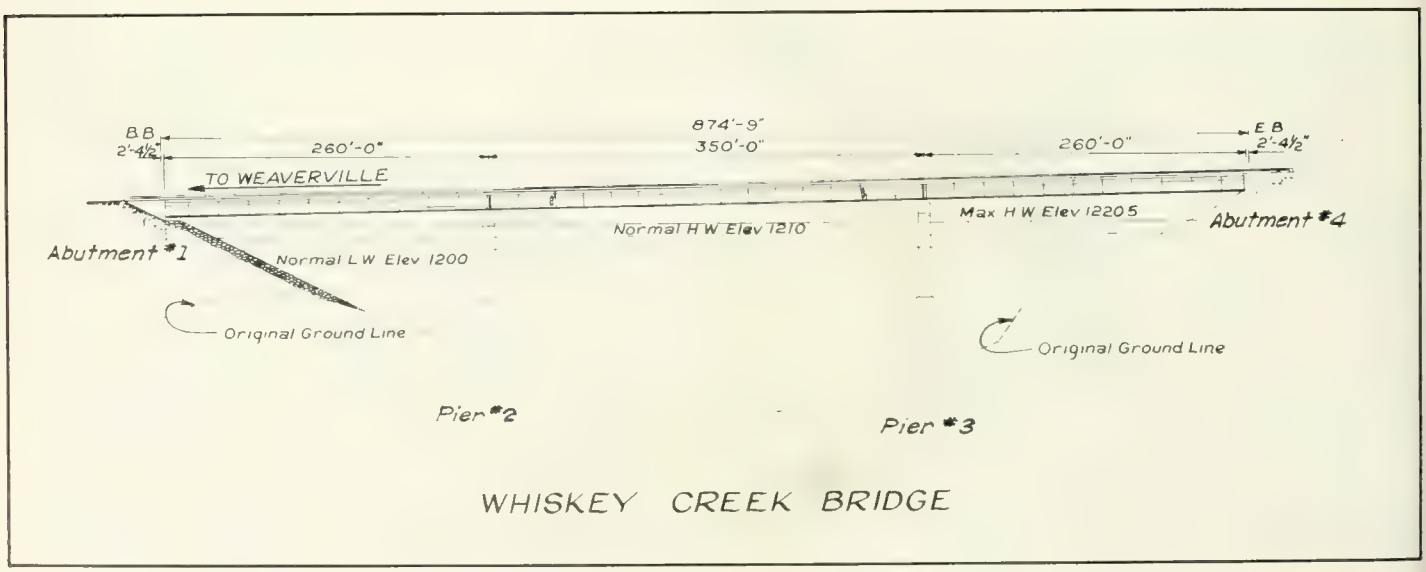
The subcontractor employed a unique method for supporting the column steel. A structural steel tower, with circular rings attached, was erected inside the column steel location. The reinforcing steel was then lifted by truck crane, placed against the rings and fastened thereto. The lower portion of the tower was left in place and is imbedded in the completed work. As the pouring of the concrete columns progressed and the bar steel became rigid enough to support itself, the remaining portions of the tower were removed for reuse in the other columns.

All columns were formed using split steel forms, 8 feet in height and stacked so that a total height of 32 feet was poured at the time.

Built-in Form Sections

Falsework for the pier caps was built on the ground in four sections and raised into position by truck crane.

Two 36-inch WF beams were placed across the columns and set atop four WF posts rising from the top of columns. Cap falsework was suspended from the beams with hangers and she-bolts. Each pier cap required 330 cubic yards of concrete and 26 hours to pour.



A profile sketch of the bridge to show the location of the piers and normal low, normal high and maximum high water levels.

Abutment One is located atop a previously placed embankment and is supported on steel piles to insure stability, as the fill is expected to settle approximately one foot after the lake is filled. Steel piles were placed in holes drilled through the fill and then driven to 100 tons bearing. The maximum depth of drilled hole was 123 feet on a one-to-three batter. Considerable difficulty was encountered in drilling, due to various sized rock encountered in the fill.

Drilling was started on January 27, 1961, and completed on May 19, 1961. Support piles were driven with a 15,000 foot pound energy single acting hammer with swing leads, supported by a 70T crane.

Set on Timber

The various sections of steel girders were set atop timber nests which were then adjusted so that camber requirements were met. The three sections were then welded together, making up one span length plus a 45-foot cantilever arm which overhangs into Span Two.

The dead load weight of the concrete deck, which amounted to over two tons per foot, was provided for in a predetermined camber. This camber as theoretically calculated was fabricated into the steel girders. Spans one and three were fabricated with 0.74 feet of camber, span two was fabricated with 1.48 feet of camber. A total of 12 field welds were made requiring over 100 man-hours per weld. A rigid control was maintained on all preheat and welding procedures used, with inspection and radiographic work being done by the Material and Research Department.

After all welding was completed the cross-bracing was bolted into place and the entire unit prepared for rolling out. The girders were then set on a 3 percent slope and pulled out, employing a cable and pulley system, attached to a 14K donkey engine.

A supplemental structural steel falsework tower was constructed halfway between the piers and abutments, to support the girders during rolling out operations. Specially designed roller nests were set atop the piers and



Two 14,000-pound lead line pull engines secured to the bridge approach start to lift the 260-foot center span into place on the new Whiskey Creek Bridge.



The lifted center span almost in place. The span was raised in eight hours with the two lead line pull engines and a series of wire rope lifting falls. Above photos by U.S. Steel Corporation.

false-bent which allowed for maximum movement with a minimum of effort. Over 300 tons of steel was rolled out; 350 feet in less than two days' time.

End Span Girders

As previously mentioned, the two end span girders cantilever into the center span and support the center span girders with 15″ x 2⅛″ "T-1" hangers and nine-inch A237 pins. A unique method was used to hoist the center span, 190 feet into final position. Steel beams were welded and braced to the top of the cantilever sections and a similar arrangement was used on the bottoms of the girders to be hoisted. A set of falls was placed between the top and bottom girders, using a 19 part ¾-inch cable at each point.

The total weight of structural steel was over 250 tons and was lifted with two 15,000-pound stationary hoists.

The limited cable capacity of the hoist drums necessitated lifting one end of the girders 10 feet, which would reel in 200 feet of cable, dogging off this cable and then reeling in the other end up a similar amount until the girders were in place. The center span was lifted and the hinge pins set, in less than two days.



The new Whiskey Creek Bridge showing the completed roadway with provision for future expansion to four lanes.

Scaffolding Used

All deck falsework was placed and removed from a scaffolding, suspended from the bottom flanges of the two main girders.

The project was opened to public traffic on November 6, 1961, and is complete except for painting of structural steel on the bridge and applying a chip seal coat to the traveled way.

The cost of the bridge across Whiskey Creek was $1,080,000 and the total construction cost of the entire project will be $4,300,000. The project is financed jointly by the Division of Highways and the U.S. Bureau of Reclamation, the bureau's share approximately 90 percent based on a "replacement in kind" cost.

Design and construction staff were chief designer, R. D. Sunbury; branch construction engineer, J. D. Pettine; assistant construction engineer, George L. Johnson; district resident engineer, M. P. Brower; steel and welding inspection, Frank Boeger, Bob Miliron; bridge subcontractor, Lew Jones Construction Company and bridge superintendent, Jerry Dooley.



A view of a section of the new relocated US 299 highway made necessary by construction of the Whiskey Creek Dam.

Snow in the South

Maintenance Crews Meet Unusual Challenge

By JOHN O'MALLEY, Highway Superintendent



On January 19, 1962, the barometer at the Ridge Route Station started down from its normal reading of 30.02 and by the morning of the 20th rain was falling throughout most of Southern California, with snow in the mountains above the 5,000-foot elevation. Chains were required on the Angeles Crest Highway above this elevation. By 11 a.m. on the 20th it was necessary to close the upper limits of the Angeles Crest due to falling rocks, drifting snow and extremely poor visibility. By 12 noon the San Gabriel Canyon road was closed due to rock slides.

In the afternoon, as the temperature dropped the snow line crept down with it. By nightfall the rain had turned to wet snow at Tejon Summit on the Ridge Route but was still not sticking in quantity to the pavement. Some sand mixed with rock salt was spread to help the heavy trucks and trailers and in the hope the snow would continue to melt as it fell to the pavement.

Snow Down to 3,000 Feet

The hope was ill founded, since by 2 a.m. on the 21st, snow was falling and sticking at the 3,000-foot level. By then sand was being applied all up and down the Ridge Route and in some short locations in Mint Canyon on US 6. Traffic was still moving, although cautiously, without chains.

Other districts were having their problems also. At 5 p.m. San Bernardino called requesting a closure on our side of SSR 138 at Victorville Junction due to a traffic tieup on Cajon Pass Road, US 66, near SSR 138 junction. At 9 a.m. reports came in that snow was now falling in the vicinity of Littlerock in the Antelope Valley. By 4 p.m. it was snowing throughout the desert areas. Mint Canyon Highway was slick with slush in many spots.

Every few minutes calls were being received from our own patrols and from various law enforcement agencies reporting locations where plows or sand was needed. Earlier in the day arrangements had been made to rent additional privately owned motor graders and the foremen were instructed to call them as the need arose. All were equipped with headlights, taillights and flashing amber lights for night use.

Snow was now falling along the entire length of the Ridge Route from Castaic to a point near Lebec in District VI, and at 8 a.m. the route was closed to both north and south bound traffic. It was re-opened approximately two hours later to all vehicles but with chains required. The intervening two hours was spent extracting traffic caught in the snow or on slippery grades without chains.

At 8.30 a.m. on the morning of the 22d, the road was again closed to all traffic because of zero visibility in the vicinity of Gorman. Gale winds blowing fine powder snow made visibility so bad maintenance crews could not find the roadway and were driving into side borrow ditches and becoming stuck themselves.

Two Inches of Snow in Glendale

Meanwhile all roads in the territory were by now completely covered with from 2 inches of snow in the Glendale and San Fernando Valley areas to 48 inches at Kratka Ridge on the Angeles Crest Highway. At Newhall 8 to 10 inches of snow piled up. At Tejon Summit the depth was 18 inches with drifts up to 4 and 5 feet.

Because of reports of marooned vehicles and occupants and because one of our own plow trucks was broken down in a drift on the Gorman to Lancaster cut-off, another plow was dispatched from Gorman to meet it. When finally the foreman reported the plow unable to buck the wind driven drifts, a call via radio was made to Wrightwood for a FWD plow. This is a new truck equipped with a 48 inch high reversible push plow, mobile ra-

Editor's Note: Every decade or so, a freak combination of weather factors produces snow in the Los Angeles area. In close proximity to the densely settled series of valleys occupied by Los Angeles and several score smaller cities, there are great open spaces of desert, and mountain ranges 8 and 10 thousand feet high. Two inches of snow in Pasadena mean several feet in the mountains, and heavy drifting on the high plateaus of the open desert. In these adjacent stretches of desert, and in the mountain passes, Southern California motorists, unaccustomed to driving in snow, unequipped with tire chains, quickly get into trouble.

The storms of late January 1962, were no exception.

Weekend visitors to vacation cabins at elevations as low as 2,000 feet found themselves snowbound, with limited supplies. Huge drifts piled up by desert winds closed the routes into Los Angeles, so that the town of Mojave, with a population of 2,500, perforce became host to 1,600 stranded visitors, and the little town of Rosamond nearby had hundreds more.

The Ridge Route, US 99, main north-south route between Los Angeles and the Central Valley, had more than a foot of snow, with drifts many times that deep in places. The run-off from the melt in the daytime froze into black ice at night, creating death traps for the unwary. In the San Gabriel and San Bernardino ranges the problem of getting out trapped weekend recreationists was complicated by the thousands who wanted to go to the mountains to play in the snow.

The accompanying unassuming narrative is an account of what the highway maintenance man faces when one of these freak storms strikes. In it a man whose job it is to organize the struggle against the storm tells of the various phases in the struggle—a struggle not only to keep the routes open for commerce, but in many cases to keep open routes by which people could reach vitally needed shelter.

dio, and carrying an auxiliary 300 gallon gasoline tank on skids in the truck bed.

Leaving Wrightwood around 5 p.m., maintenance man Paul Johnson plowed through light snow to the Lancaster Station, arriving around 8 p.m. Receiving instructions and directions from the foreman, Johnson headed north on US 6 and west on SSR 138. The FWD truck moved along with little effort in the 12- to 18-inch snow depths but had to do some backing and cutting where drifts had piled up to four or five feet deep on the highly superelevated right angle turns.



Rotary snow plow clearing State Sign Route 18 in the San Bernardino Mountains between Lake Arrowhead and Big Bear.

Plow Breaks Road Open

By early morning of the 23d Johnson had plowed across SSR 138 west of US 6 and had made contact with the foreman from the Ridge Route. Between them they had collected together 8 to 10 cars including 1 from the Lancaster Office of the Los Angeles County Sheriff's Department. Turning east now, Johnson in the FWD plow led the cars back to the junction of the US 6 highway, from which location they were able to proceed to Lancaster without further help from the plow.

At this point he again reversed his course and returned west across the desert to work out the following day on the Ridge Route. (Johnson is new to the Wrightwood section and had never traveled over SSR 138.) His only guides were a line of power poles running alongside the highway. Total distance from Wrightwood to US 99 near Gorman is 98 miles. Including doubling back it is estimated he covered approximately 180 to 190 miles on this trip. Reports from the Sheriff's Office indicate that except for inconvenience and discomfort none of the marooned persons were any the worse for wear. Without this or a similar type plow it is only a guess as to what might have been.

On the morning of January 25th, storm is over, pavement is clear and dry with normal traffic movement over the Ridge Route, US 99.



Meantime other crews were having their own problems with urgent calls by the California Highway Patrol and the local Sheriff's offices. In the La Canada area, the chain control sign was removed from its usual location 12 or so miles north of Foothill Boulevard on the Angeles Crest, right down to Foothill Boulevard itself.

US 99 Closed in L.A. City Limits

On US 99 (Golden State Freeway) the snow was falling and sticking well

inside the city limits of Los Angeles. This condition brought out the Los Angeles Police Department where at the junctions of US 99 and Sepulveda Boulevard they called for barriers and signs and manned a "road-closed" blockade. Although officially the road was closed, they allowed all residents and those having business in the Newhall-Saugus area to proceed if they had chains on.

Off and on between January 22d to the 23d various routes were closed, opened and closed again as conditions of snow, ice and traffic congestion warranted. The push plows on the Ridge Route had about reached their capacity to windrow the snow to the sides of the road, so on the 23d a radio message to Chilao on the Angeles Crest started one of the rotary plows on its way to the scene. By now the storm was tapering off to some extent and all equipment was concentrated on sanding the ice, scraping and heeling back the pushed snow and the rotary plow was busy spewing the five- to six-foot high reefs of snow far from the road.

During the night of the 23d and early morning of the 24th, traffic was allowed to proceed over the Ridge Route in groups of 25 to 30 vehicles without chains. This was so that in the event anyone became stuck, it would be a relatively simple matter extricating them without the loss of time attendant on hundreds of cars and trucks being released at one time and all stuck together. By early morning all traffic was running without any wait on either end and all controls were eliminated. On the 24th, the sun came out, the storm was over, and the next couple of days were spent in cleanup work, servicing of all equipment and in general getting back to normal.

260 Miles of Road

Where normally 90 miles of roadway is under snow or ice as a maximum in this area, the January storm covered 260 miles in varying depths from two inches to four feet with some drifts six feet deep in desert areas and side hill drifts 15 feet or more in the mountains. Seven private contractor graders were used along with the State-owned equipment enumerated previously. Twenty-four tons of rock salt mixed with approximately 1,200 to 1,400 cubic yards of sand was spread, most of this over a one night and day period.



Angeles Crest Highway in San Gabriel Range on 26 January, 1962. Photograph is made less than 40 miles from downtown Los Angeles.

Simple statistics can't tell the story of the battle waged by each individual, but during a storm of this type the spirit of the men assigned the task of keeping the roads passable is admirable. The work is hard on men and equipment. Operations are necessarily continuous. Most of the time it is not possible to provide a relief operator at the end of a regular shift. In such cases the men carry on until they can be relieved.

The storm is over; not as spectacular as those occurring on some of the northern mountain passes and with less lasting results, since a week later with the temperature soaring into the 80's all the snow is gone with the exception of that in the higher elevations of the Angeles Crest. We hope the average between these "unusual" storms holds true in which case it will be at least 1970 before the next one—but then who knows—maybe next week.

NEW RECORD FOR REGISTRATION FEES

A record of $264,406,499 in registration and drivers' license fees was collected in 1961 by the Department of Motor Vehicles.

This is nearly $6.5 million more than the revenue collected in 1960.

Parts of the $264 million are apportioned for use by cities and counties, and for state highway planning, construction and maintenance.

The motor vehicle fee is a major source of funds for California's highway program. More than $56 million of the 1961 motor vehicle fees is earmarked in the current state budget for this purpose. This large sum is exceeded only by funds from gasoline tax and federal highway aid.

More than $127 million is divided equally between cities and counties, apportioned on the basis of population. This is the amount received from the 2 percent valuation fee assessed vehicles in lieu of local property taxes.

Counties may use their apportionments as their governing bodies direct, but legislation limits use of cities' funds to three areas: law enforcement, traffic control and regulation, and fire protection of highway traffic.

Part of the balance remaining after apportionments to cities and counties and to highway programs is used to support law enforcement and public safety activities of the California Highway Patrol. Another part of the balance is used to support driver licensing, driver improvement, vehicle ownership identification, and record maintenance services of the Department of Motor Vehicles.

Snow! Snow! Snow!

The snow had barely melted in Southern California (see previous page) when a series of storms again swept in from the Pacific. Rain fell heavily over most of the State, with snow in the mountains. One station in the northern Sierra Nevada recorded 45 inches of snow in one day.

Snow built up on the high ridges, and overhanging cornices began to form. On a section of US 50 west of Echo Summit which had to be closed because of avalanche danger, the National Guard gun crew pictured below, with its jeep-mounted 105 mm. recoilless rifle, fired several rounds into a series of cornices above the closed section of road. The resultant slides removed the danger.







BELOW: Cornices above Meyers Grade section of US 50 were bombed by helicopter in attempt to loosen hanging snow.



n control station at Strawberry on US 50 during heavy snowstorm. (See page 61.)



L.A. Area Freeways

By E. T. TELFORD, Assistant State Highway Engineer



Although 1961 was not an impressive year for actual freeway mileage opened to traffic in District VII, the construction program in point of dollar investment accruing from several fiscal years showed substantial gains over previous years. Despite the fact that only 11.2 additional miles of freeway were made available to the motoring public, $251,890,368 in construction funds was invested in minor and major highway contracts of all types during the single month of November, accumulating from jobs let during the year.

The quarter of a billion dollar peak was indicative of the intensive construction program in Orange, Ventura and Los Angeles Counties; and portended a banner year of freeway completions for 1962, when an estimated 50 miles of freeways worth $150,000,000 would be opened to public use.

As of February 20, 1962, District VII had 334 miles of freeway and expressway completed and in operation, 83 miles under construction and 721 miles of adopted routes. Los Angeles County alone had 225 miles of freeways-expressways completed and 63 miles of freeways under construction.

The completed Glendale Freeway, looking southwest to Glendale Boulevard. In the foreground is the Glendale-Golden State Freeway Interchange.



The total investment in freeways for the three counties of Los Angeles, Orange and Ventura, including rights-of-way and construction, was $1,191,158,000, as of December 31, 1961.

Freeway Loop Dedicated

Perhaps the most important single event occurred on March 30, 1962, when 23 miles of the Interstate Santa Monica-Golden State Freeway Loop was dedicated by Governor Edmund G. Brown. It marked a major breakthrough in freeway development for the Los Angeles Metropolitan Area; since in effect an entirely new route, formed by portions of the two freeways, was added to the metropolitan network. Of special significance was the fact that an alternate bypass facility skirting the fringes of downtown Los Angeles and more or less paralleling the existing Hollywood Freeway was now a reality.

Traffic could now avoid the heavily travelled Hollywood Freeway—a daily average traffic of 195,000 vehicles per day in 1961 just west of the four-level structure—and find its destinations along the Santa Monica-Golden State Freeway connection. Moreover, interchange facilities were provided with other mainline freeway routes, such as the Santa Ana, San Bernardino, Pasadena, Glendale and Ventura Freeways.

Conservative traffic estimates held that 15 to 20 percent of the traffic using the Hollywood Freeway would be diverted to the new route. In addition, traffic congestion on busy San Fernando Road and Riverside Drive would be sharply reduced in that an estimated 80 percent of the traffic on these two arterials in the vicinity of the downtown area would divert to the new freeway.

Freeways Being Extended

The Santa Monica-Golden State Freeway Loop has its origin at the Harbor Freeway at Venice Boulevard and its terminus at Lankershim Boule-

yard in the San Fernando Valley; however, independently, both freeways are being extended west and north. The Santa Monica Freeway will eventually terminate at Pacific Coast Highway in Santa Monica and the Golden State Freeway continue north into Kern County.

The 23 miles of the loop has been built at a construction cost of over $95,000,000 and a right-of-way cost slightly in excess of $88,000,000 since the first contract on a Golden State Freeway link was completed in September, 1957.

Anticipated traffic use of the Santa Monica Freeway portion of the loop as far west as the Harbor Freeway is 70,000 vehicles per day in 1962; by 1980 this freeway will be carrying 180,000 vehicles between Los Angeles and Santa Monica. The Golden State Freeway is expected to be carrying 163,000 vehicles per day in 1980. The East Los Angeles Interchange, where the Santa Monica and Golden State Freeways converge, will be carrying an estimated 450,000 automobiles and trucks, or 600,000 individuals, by 1980.



The desirability of business locating next to a freeway, in this case the San Diego Freeway in the Dominguez area, is illustrated by this realtor's sign.

"Thus another component is added to the growing network of freeways in Metropolitan Los Angeles that will begin to function as a system, providing alternate routes to accommodate the areawide traffic flow patterns. To





The location of the Golden State-Santa Monica Freeway Loop is shown in the above map.

the individual, system operation will mean greater speed, safety, convenience and comfort in the movement of himself and his goods between points of his choice at a time suitable to him. The completion of this important distribution complex will implement the switching of traffic between freeways and the diffusion of traffic into local streets." ("L. A. Renaissance," *California Highways and Public Works*, September-October, 1961.)

Interstate System

Freeway development in District VII and throughout California has been greatly accelerated under the National System of Interstate and Defense Highways, beginning in 1956. The 41,000-mile system is largely financed from the federal gasoline tax. There are a total of 2,179 miles of freeway on the Interstate System in California, of which 654 miles were completed and opened to traffic as of December 31, 1961. The Interstate network in District VII totals 328.5 miles, of which 167 miles were completed and opened to traffic on December 31, 1961.

During 1961 only eight miles of Interstate freeways were added to the 115 miles in operation at the end of 1960; exclusive of the 44-mile Golden State expressway portion; however, work was carried forward on 37 more miles under construction by the end of the year. Completion of the work now under way will in significant measure bring to the travelling public a realization of the free-flowing peak-hour traffic conditions which can be afforded by a system of modern freeways.

Right-of-way activity was extensive during 1961 in preparation for the projects budgeted by the end of the year, which will add 38.4 miles to the system.

In review, the Interstate System is of prime importance to the District VII freeway pattern. It is so constituted that it will not only efficiently perform its function of interstate travel and national defense but will also incorporate some of the most important elements of our freeway network. Some measure of its importance is reflected by the fact that about 35 percent of the annual highway expenditures during the next decade will be needed for Interstate freeways. Three hundred thirty of the 920 miles of freeways and expressways to be placed under construction in the district by 1972 will be Interstate freeways. Nearly 80 percent of the mileage will have eight or more through lanes and nearly all the rest will be six-lane freeways. Thus 36 percent of the freeway mileage in operation by 1975 will carry over 45 percent of the freeway traffic.

At the end of 1961 Interstate freeways (including present expressways) totalled 167 miles or 51 percent of the 327 miles of freeways and expressways in operation in District VII. Two hundred fifty-six miles or 35 percent of the 721 miles adopted are Federal Aid Interstate routes.

San Diego Freeway

The San Diego Freeway, Interstate Route 5 and 405, is 93.6 miles in length in District VII, originating at junction with the Golden State Freeway at the San Fernando Reservoir and extending past San Clemente into San Diego County. As of December 31, 1961, $220,345,000 had been in-

vested in this route for both rights-of-way and construction.

As of this writing, the route is under construction from the Golden State Freeway to Burbank Boulevard, under two contracts totalling almost $8,000,000 a distance of 10 miles (two grading projects having been completed earlier). The freeway is completed from Burbank Boulevard to Valley Vista Boulevard, from which point it is under construction under $19,993,000 contract across the Santa Monica Mountains to Casiano Road in West Los Angeles. South of Casiano Road the freeway is completed to Jefferson Boulevard.

A continuous line of active construction projects worth $42,673,000 takes the freeway 17.5 miles south and east to Alameda Street in the Dominguez area, where it connects with a previously completed link to the Long Beach Freeway, opened to traffic on January 25, 1962. Other San Diego Freeway roadway and bridge contracts are in progress east of the Long Beach Freeway to Studebaker Road. (See *San Diego Freeway*, by James E. Martin, *California Highways and Public Works*, January-February, 1962.)

The 1962-63 Highway Budget provides $23,000,000 for the completion of this route to ultimate freeway standards as far as Bolsa Chica Road in Orange County.

The remaining unbudgeted and unconstructed portion of the San Diego Freeway in Orange County is about 22 miles in length and extends from Bolsa Chica Road at the Garden Grove Freeway to a junction with the Santa Ana Freeway near El Toro. Initial construction will provide eight lanes from Bolsa Chica Road to Central Avenue and six lanes from Central Avenue to the Santa Ana Freeway.

Road Settlement Indicated

In the Cities of Westminster and Huntington Beach, there are peat deposits located within the proposed freeway limits. Tests indicate substantial settlement can be expected in the roadway embankments constructed over these deposits. Therefore, roadway embankments will be constructed at an early date to provide the maximum time for settlement prior to construction of the freeway pavement.



Looking east along the Santa Monica Freeway viaduct. Note the translucent headlight glare shield mounted on the concrete divider (left).



Chain-link cable-reinforced median barrier fence is being installed on District VII freeways. This is an experimental section at Kellogg Hill on the San Bernardino Freeway. It is equipped with an expanded metal anti-glare shield.



ABOVE—An eastward view of construction on the Ventura Freeway from the Hollywood Freeway Interchange (foreground). BELOW—The temporary end of the loop portion of the Golden State Freeway. The view is east with San Fernando Road running diagonally (center).



ABOVE—The Santa Monica-Harbor Freeway Interchange at Venice Boulevard. This is the temporary terminus of the Santa Monica Freeway and end of the loop. BELOW—Looking east along the San Bernardino Freeway. The Atlantic Boulevard Interchange is center and, at left, the Ramona Convent.





This will be accomplished under a separate contract for constructing embankments and fence between Edinger and Bolsa Avenues for which the California Highway Commission voted $700,000 in January 1962.

Design of 5.8 miles of the San Diego Freeway between Beach Boulevard and Bolsa Chica Road is scheduled to be completed during 1962. This unit will provide freeway interchanges at Springdale Street, Westminster Avenue, Golden West Street, Bolsa Avenue and Beach Boulevard, plus crossings at Edwards Street and Sugar Avenue. In excess of 85 percent of the right-of-way required for this project has been acquired.

From Beach Boulevard, southeasterly to Harbor Boulevard, a distance of 5.3 miles, design is well under way and about one quarter of the necessary right-of-way has been acquired. Interchanges will be located at Edinger Avenue, Cannery Street, Warner Avenue, Brookhurst Street, Talbert Avenue, Euclid Street and Harbor Boulevard. Newland Street and Bushard Street will cross over the freeway.

Design on the final section of the San Diego Freeway between Harbor Boulevard and a junction with the Santa Ana Freeway near El Toro, about 11 miles in length, will get under way as soon as the matter concerning the compatibility of the proposed Orange County Airport improvement and the adopted route for the San Diego Freeway is resolved.

San Gabriel River Freeway

The San Gabriel River Freeway, Interstate Route 605, extends 22.6 miles from the San Bernardino Freeway in El Monte to the Garden Grove Freeway in Westminster. Studies are in progress to extend the adoption of this route north from the San Bernardino Freeway to the Foothill Freeway and south from the Garden Grove Freeway to Pacific Coast Highway. Right-of-way purchases on this route amounted to $25,007,000 as of December 31, 1961, with an additional $5,100,000 included in the 1962-63 fiscal year.

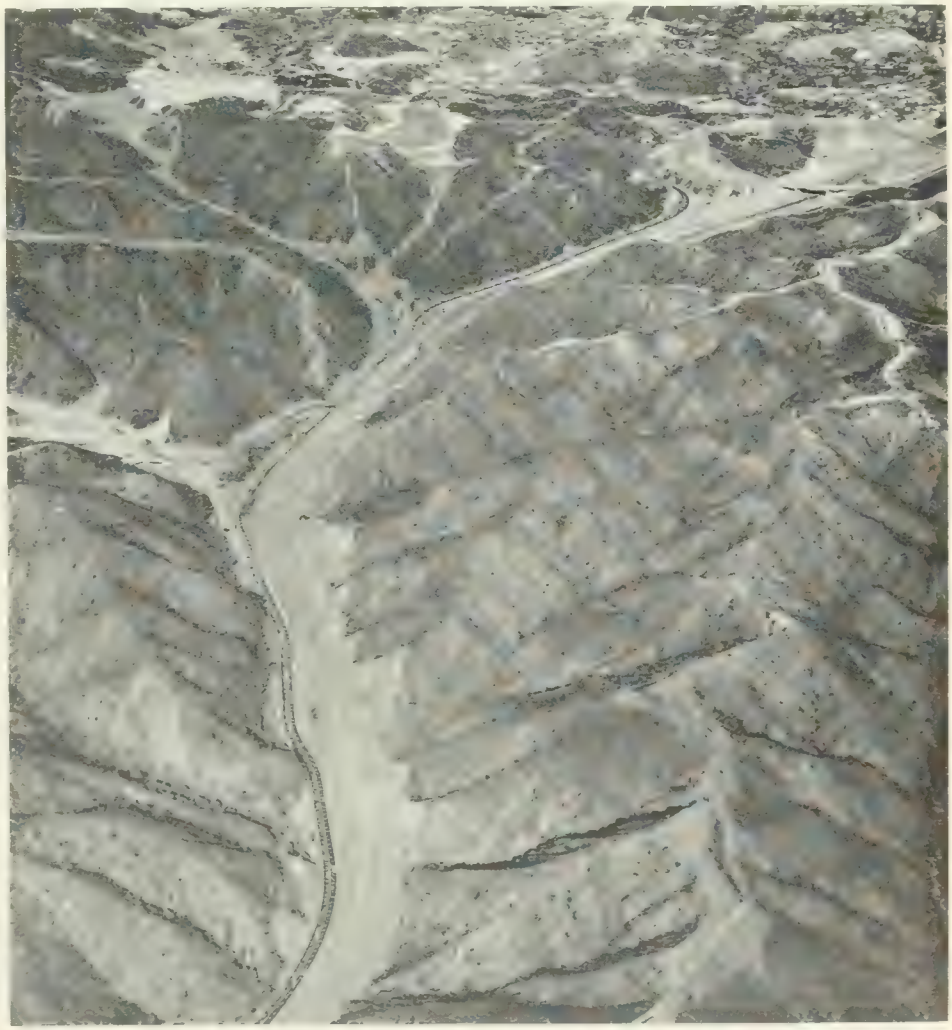
Initial construction on the San Gabriel River Freeway is now under way, a $649,432 contract having been awarded on February 6, 1962, for the Peck Road overcrossing and interchange in the Whittier area.

The 1962-63 budget includes $11,550,000 for construction of seven miles of the San Gabriel River Freeway between Whittier Boulevard and the San Bernardino Freeway. It is anticipated that two contracts covering this section will be under construction by late 1962. Plans are rapidly nearing completion for the remaining 15.4 miles of the San Gabriel River Freeway between the Garden Grove Freeway and Whittier Boulevard.

It is anticipated that the design of the portion of the San Gabriel River Freeway between the Garden Grove Freeway and the Orange-Los Angeles County line near Katella Avenue will be completed early in 1963. The initial construction will provide full freeway facilities with four lanes in each direction separated by a 36-foot median. Construction of this three-mile section could commence in 1963, subject to financing. The estimated construction cost is $7,000,000.

Golden State Freeway

The Golden State Freeway, Interstate Route 5, is virtually completed to freeway-expressway standards from junction with the Santa Ana-Santa Monica Freeways in East Los Angeles to the Kern County line north of Gorman, a distance of some 73 miles. Two construction projects in progress now between Lankershim Boulevard and San Fernando Road, stretching eight miles and costing $14,774,000, will make the route continuous from central Los Angeles to the north Los Angeles County limits by the summer of 1963. The total investment in the



Construction on the San Diego Freeway through the Santa Monica Mountains. The view is northward. The black roadway is realigned Sepulveda Boulevard.



The sweeping curve of the Griffith Park Road overcrossing on the Golden State Freeway.

route as of December 31, 1961, for both rights-of-way and construction, was $153,603,000.

During 1961 two vital links were completed and opened to traffic on the Golden State Freeway: Burbank to Roscoe Boulevards, 3.4 miles, $5,980,000; and Roscoe to Lankershim Boulevards, 1.9 miles, $3,724,000. Two other jobs, across the Glendale and Pasadena Freeways, were opened to traffic in March 1962 between Pasadena Avenue and Glendale Boulevard, at a construction cost of $21,573,000, adding four continuous miles to the route and filling in the loop portion of the Golden State Freeway.

Plans are afoot to convert the existing 43.6-mile expressway section of the Golden State Freeway to full freeway standards from the north city limits of Los Angeles to the Kern County line. This portion of Interstate 5 carries traffic northward over the Tehachapi Mountains into the San Joaquin Valley and the San Francisco Bay area. At the present time the average daily traffic is 15,000 motor vehicles, but it is expected to increase to 45,000 in the next 20 years. Almost 20 percent of the traffic is generated by commercial vehicles.

In June 1961 a public hearing covering the northerly 13 miles of the route was held in Gorman. Another hearing on the southerly 18 miles of the expressway section was held on January 4, 1962, followed by a notice of intention by the California Highway Commission to adopt a route. Following formal adoption of a freeway line, all of the route will be under active design. Conversion to full freeway standards will cost an estimated $5,000,000 for right-of-way and $90,000,000 for construction.

The 1962-63 construction budget provides $5,500,000 for initial work on 4.5 miles of the Golden State Freeway (together with a connection to the future Sign Route 126 Freeway paralleling the Santa Clara River at Saugus-Ventura Road) south of Castaic.

Design is presently under way on the Golden State Freeway south of the Kern County line. At a point seven miles south of the line there will be a connection with the proposed Metropolitan Bypass and the future Lancaster Freeway, which will provide a more direct route to the Antelope Valley and San Bernardino in lieu of passing through the Los Angeles area.

Foothill Freeway

The Foothill Freeway, Interstate Route 210 and State Sign Routes 9



Looking north along construction on the San Diego Freeway at the San Fernando Reservoir (left). This will be the future location of the San Diego-Golden State Freeway Interchange.

and 190, measures almost 53 miles in length from the Golden State Freeway to the San Bernardino County line. Thirty-four miles of the route have been adopted, and a California Highway Commission hearing on a 5.6-mile link (estimated to cost $46,300,000) through the cities of Pasadena and Arcadia was held on March 27, 1962. Except for a short section of the freeway built in the Flintridge-Altadena area in 1955 at a cost of $2,098,000, the freeway is in planning and design stages. Total expenditures on the Foothill Freeway to December 31, 1961, were $10,857,000 for both rights-of-way and construction, with an additional right-of-way allocation in the 1962-63 budget of $7,500,000.

Development of the Interstate mileage of the Foothill Freeway to 4-, 6-, and 8-lane standards from the Golden State Freeway to junction with the future Corona Freeway extension, a distance of 42 miles, is estimated to cost an additional $89,000,000 for construction and $94,000,000 for rights-of-way.

Route location studies for the not yet adopted link of the Foothill Freeway between the completed part across Arroyo Seco Park near the Rose Bowl and Foothill Place near Hansen Dam (10 miles) will be announced in the near future. However, studies for the link between the Colorado Freeway and Arroyo Seco Park (2 miles) are in progress.



The San Bernardino-Golden State Interchange. The view is east along the San Bernardino Freeway.

Santa Monica Freeway

The Santa Monica Freeway, Interstate Route 10, extends for a distance of 17 miles from Pacific Coast Highway in Santa Monica to the Santa Ana Freeway in Los Angeles. At the close of 1961, $129,090,000 had been expended on this route for rights-of-way and construction.

After preliminary bridge work completed between 1957 and 1959 in the downtown area, the first usable link of the Santa Monica Freeway was completed and opened to traffic on December 4, 1961, connecting with the East Los Angeles Interchange. The one-mile link from 8th Street to Hooper Avenue cost $9,305,000 to construct. In January 1962, another 1.2-mile segment from Hooper Avenue to Main Street was completed at a cost of $7,295,000, followed by the Main Street to Oak Street portion and interchange with the Harbor Freeway, dedicated at special ceremonies by Governor Edmund G. Brown on March 30, 1962. This tail end of the loop measures almost a mile in length and cost $9,360,000 to build.

Other jobs on the Santa Monica Freeway west of the Harbor Freeway are in progress under bridge and roadway contracts, pushing completion of the entire freeway westward to the coast by 1965.

These jobs are as follows: Oak Street to Vermont Avenue, 0.6-mile, $4,898,000, estimated completion date June 1962; Hoover Street to Hillcrest Drive, 0.4-mile, $3,874,200, estimated completion date November 1962; and Colby Avenue to 21st Street in Santa Monica, $1,157,200, estimated completion date June 1963. Bids were opened on March 8, 1962, and construction is in progress under a $3,477,609 contract on still another project between Overland Avenue and Sawtelle Boulevard.

Budgetary allotments in the 1962-63 fiscal year plus projects in progress assure the completion of this route to full freeway standards from downtown Los Angeles to the San Diego Freeway. Construction funds allocated, limits and lengths of the projects are as follows, from east to west: $10,800,000, Hoover Street to Fairfax Avenue, 5 miles; $3,700,000, Fairfax Avenue to La Cienega Boulevard, 0.5-mile; $6,700,000, La Cienega Boulevard to Overland Avenue, 2.2 miles; and $7,300,000, Overland Avenue to Sawtelle Boulevard, 2.6 miles. Also, $6,900,000 has been budgeted to acquire additional right-of-way necessary for the Santa Monica Freeway.

The Santa Monica Freeway is an important radial route, forming the most direct route to the beach areas from the central Los Angeles area; it will form the first and most important west-east freeway serving the southwest Los Angeles area, linking the several outlying "belt" routes to the central metropolitan area; allowing a greater variety of alternate routes within the system; and finally forming the main link between the greater Los Angeles area and all points east.

Completion of the last 3.4-mile unit of the Santa Monica Freeway will cost $7,500,000 for construction. Also, an estimated $10,800,000 will be required to purchase the balance of the right-of-way on the entire 17-mile route. These moneys have not yet been budgeted but early financing is anticipated.

San Bernardino Freeway

The San Bernardino Freeway, Interstate Route 10, has been completed for a number of years in this district, from its origin at the Santa Ana Freeway near the Los Angeles River to the San Bernardino County line in Claremont, a distance of 30.6 miles. As of December 31, 1961, a total of $62,322,000 had been invested in this route, including rights-of-way and construction.

The San Bernardino Freeway was put into full operation as a 4- and 6-lane highway prior to 1958 by 13 major contracts amounting to $31,100,000. Before 1961, $5,600,000 had been spent on 28 other contracts for widening, roadside development and other minor projects.

Completed during 1961 were five contracts for median barriers, widening and interchange work in the amount of $4,400,000. Jobs in progress or placed under construction during the year totalled three, worth $400,000. Three more projects were financed in the 1961-62 budget year for $500,000. A widening project between Holt Avenue near Covina and San Dimas Avenue is under $841,850 contract scheduled for completion in September 1962, which will add another lane to the freeway for a distance of three miles.

Future plans call for 10 other projects on the San Bernardino Freeway to include widening, roadside development, median barriers and interchange work to complete the route as an eight-lane freeway (with additional through lanes in critical areas) at a cost of $18,100,000 for construction. Further expenditures for right-of-way to complete this portion of Interstate 10 to full freeway standards are estimated to amount to nearly $12,000,000, primarily for minor realignment and widening.

Santa Ana Freeway

The Santa Ana Freeway, Interstate Route 5, is another freeway that has been in operation as a 4- and 6-lane facility since 1958. As of December 31, 1961, a total of $75,746,000 had been obligated on this 42.8-mile route for rights-of-way and construction from the vicinity of El Toro in Orange County to Spring Street in Los Angeles.

This route, as well as others on the Interstate System, is being modernized to meet growing traffic demands. During 1961 several miscellaneous contracts for improvement of the route were completed at a cost of $939,000, including a widening project between Eastern Avenue and Atlantic Boulevard. At the close of 1961 other similar projects amounting to more than $1,250,000 were in progress, and on February 23, 1962, a $1,169,200 contract was awarded for widening to six lanes of the freeway between South Street in Anaheim and the Santa Ana River, four miles, with an anticipated completion date of November 1962.

On January 3, 1962, a $3,620,000 contract was awarded for improvements of the Santa Ana Freeway in

The Broadway Shopping Center along the Santa Ana Freeway in Anaheim.



The May Company Shopping Center in West Covina along the San Bernardino Boulevard.



the vicinity of Santa Ana River as a part of construction of the Santa Ana, Orange and Garden Grove Freeway Interchange. Additional allocations remain in the 1961-62 fiscal year to complete the interchange and reconstruct the Santa Ana Freeway between the Santa Ana River and Main Street.

The portion of the Santa Ana Freeway between Main Street in Santa Ana and the proposed junction with the San Diego Freeway near El Toro is at present a four-lane facility. Detailed plans for the addition of a median lane in each direction are expected to be completed by March 1963. The estimated cost of the addition of these lanes is $3,500,000 for the 12 miles involved.

After the 1962-63 fiscal year, six widening projects and interchanges are planned for the Santa Ana Freeway to bring it up to interstate standards as a six- and eight-lane freeway. These improvements are estimated to cost $16,100,000 for construction and $11,600,000 for rights-of-way, primarily for future freeway interchanges.



The Sears Shopping Center in El Monte along the San Bernardino Freeway.

Noninterstate Routes

It is evident from the foregoing résumé of interstate routes that continued federal aid at present levels is furthering the rapid development of the National System of Interstate and Defense Highways in District VII to the extent that one-half of the proposed network is already completed and opened to traffic. This network constitutes the skeleton or nucleus of the overall state system of freeways and expressways planned for Los Angeles, Orange and Ventura Counties, representing a combined interstate and noninterstate mileage of 1,577. The key role of interstate freeways in the projected comprehensive network is and will continue to be manifest as noninterstate freeways are constructed to provide interconnecting or system operation.

Good progress is being made on the planning, design and construction of the numerous noninterstate routes in the district. Key links in the freeway system already have been or will be completed and opened to traffic during the course of 1962, some of the more significant of which are as follows:

Ventura Freeway, Telephone Road to Palm Street, 4.5 miles, $8,948,000, September, 1962; Palms Street to west of the Ojai Freeway, 2.7 miles, $6,848,000, July, 1962; Hollywood Freeway to Buena Vista Street, 2.8 miles, $6,479,000, November, 1962; Buena Vista Street to Golden State Freeway, 2.4 miles, $3,811,000, March, 1962.

Glendale Freeway, Los Angeles River to Riverside Drive and Riverside Drive to Glendale Boulevard, 1.3 miles, $3,156,000, March, 1962.

Hollywood Freeway Extension, Vineland Avenue to Chandler Boulevard, 0.7-mile, $2,588,000, August, 1962.

Harbor Freeway, 208th Street to Pacific Coast Highway, 4 miles, $6,035,000, July, 1962.

Newport Freeway, Riverside Freeway to Chapman Avenue, 3 miles, $4,400,000, March, 1962; and Chapman Avenue to Santa Ana Freeway, 3.5 miles, $4,158,000, September, 1962.

Economic Impact

The impact of the freeway network on the growth and economic stature of communities and areas is varied and far-reaching. The picture is not new. The economic strength of our nation has been and is the free flow of interstate commerce over our transportation systems. The economics of transport are time and operating costs. The modern freeway and freeway system reduces both time and operating costs in the motor transportation field.

What are the more immediate effects of these freeways on a community or area? Again it is not a new story but the old one of accessibility to a transportation system. As a new freeway is projected into an area, it increases accessibility to areas of employment and trade. The immediate result is a "spill-out" of population from the more crowded areas. This is particularly true in the Los Angeles area, where the tendency has been to



The Santa Ana Freeway passes through the East Los Angeles Interchange (left foreground). The Santa Monica Freeway connection is to the left, the Golden State Freeway connection is to the right.

suburban type living coupled with the fact that no metropolitan area in the United States is more dependent upon the automobile.

This increase in population soon creates a demand for additional housing and retail business establishments to serve its needs. Major shopping centers appear and offer additional opportunity for local employment and attract customers from other areas—factors which bolster financial economy. These developments also play an important role in the production of public revenues by not only adding their own assessed valuation to the tax rolls, but also by their direct effect of increasing the value of surrounding properties and enhancing their economic stability.

Location of major shopping centers in relation to the Freeway System in District VII provides an illustration of this:

Fashion Square, Santa Ana – Located adjacent to the completed Santa Ana Freeway and the proposed Garden Grove Freeway in an area formerly devoted to a citrus grove. Features a new department store, which draws trade from outside of Orange County, and a variety of high-class specialty stores.

Broadway Shopping Center, Anaheim—Located immediately north of Santa Ana Freeway on former agricultural land. Features a major department store and about 20 other stores.

Eastland Shopping Center, West Covina—Located on the northerly side of the San Bernardino Freeway on formerly undeveloped land. Features a major department store and numerous other variety and specialty shops.

Five Points Shopping Center, El Monte—Located adjacent to the San Bernardino Freeway in an area composed of vacant lots and small single family residences. Features a retail and mail order department store and many other shops.

Sherman Oaks—Located northerly of the Ventura Freeway on property formerly used for a boys' home. This is a new shopping center now under construction.

It will feature a major department store and specialty stores.

It is obvious that the presence of a freeway does not totally determine the location of major shopping centers. The economic impact of the freeway system on the area, however, plays a very important role in creating the need for these centers. Accessibility to the freeway system greatly influences the size of their potential area of service.

Importance of Industry

Industry is also an important factor in the growth and economic stature of a community. Factors affecting industrial growth are: (1) a potential labor market; (2) economic transportation of raw materials to its doors; and (3) rapid delivery of the finished product to marketing centers. The effect of the availability of a freeway facility that is a part of or connects to a national network of freeways, such as the Interstate System, on the transportation factor cannot be overemphasized. By reducing commuting time, the freeway also expands the potential labor market by increasing the area from which industry may draw upon for labor.

Within District VII we note along the Santa Ana Freeway the expansion of the Los Angeles Central Manufacturing District, the industrial development westerly of Buena Park and in the Anaheim area. In the Woodland Hills-Canoga Park area and at Newberry Park along the Ventura Freeway we see new manufacturing centers being established.

In its brochure to industry the Pomona Chamber of Commerce stresses the availability of the existing San Bernardino (Interstate Route 10) and Corona Freeways, as well as the proposed Foothill and Pomona Freeways. In the northeastern section of Anaheim adjacent to the Riverside Freeway a rapid expansion of industrial and manufacturing plants is taking place. In southern Santa Ana near the proposed intersection of the Newport Freeway (under construction), the proposed San Diego Freeway and MacArthur Freeway, a high concentration of new industrial plants is occurring.

Example of Freeway Influence

As an example of the widespread influence of freeways, let us look at the City of San Clemente. This city is

essentially a residential and seaside resort community located approximately halfway between Los Angeles and San Diego. In 1955, when the State was acquiring right-of-way for the San Diego Freeway, residential lots of average size could be purchased for $1,000 to $1,500. Today with the completion of Interstate Route 5 between San Clemente and Los Angeles, these same properties sell for $4,000 to $6,000, roughly a 400 percent increase in six years.

What is the story behind this phenomenal rise in property values? Certainly it is not due to the completion of the freeway alone. Improvements in public facilities such as water supply and sewers, increased activities at nearby Marine Corps bases and the phenomenal population increase in Orange County have all played a part.

On the other hand, we do have the situation that in 1955 the nearest major area of employment, the Tustin-Santa Ana-Anaheim area required a commuting time of approximately one hour over a conventional highway, the bulk of which was a two-lane road carrying an appreciable amount of truck traffic. With the completion in 1961 of the last link of the freeway now connecting these two areas, this commuting time has been reduced to an average of 30 minutes. Couple this with the industrial growth of the Tustin-Santa Ana-Anaheim area providing increased opportunities for profitable and stable employment and we can readily see the direct influence of the freeway on the economic welfare of the City of San Clemente.

Local influences within the city itself have been the removal of the through auto and truck traffic from one of the two main business streets permitting a free flow of local traffic. The business district is now expanding along the former highway, which eliminates the necessity of the business district located on the cross street to encroach any further into a desirable residential area.

Reflected in Major Centers

It must be remembered that the economic impact of a freeway system is not confined to the new areas or communities which it makes more accessible. It is also reflected in the major centers from which it emanates and connects together.

Los Angeles, the nation's third largest manufacturing center and second largest population and retail center, has experienced the impact through the increased accessibility to the Ports of Los Angeles and Long Beach by the direct freeway links to them. In particular, the Long Beach Freeway, which also connects directly to Interstate Route 5 (a north-south route) and 10 (an east-west route), is a direct line between the Central Manufacturing District and the Port of Long Beach.

A five-day field survey by the Automobile Club of Southern California covering 342 miles of surface streets and freeways over 17 routes from various suburban areas to downtown Los Angeles during morning and evening peak hours showed these results: With the addition of 47.5 miles of freeway system between 1957 and 1960, an overall average speed was found to be 26 miles per hour as against 24 miles per hour in 1957 in spite of an increase of 11 percent in the number of vehicles in the area.

As more miles of freeway are completed in this area, the reduction in travel time, in spite of increased numbers of vehicles, continues. Through this increasing reduction in commuting time, outlying areas and adjacent communities are becoming more homogeneous and the economic stature of the entire area is increased.

Looking toward Ventura and the sea along construction on the Sign Route 126 Freeway. Cross Street in the foreground is Harmon Baranca.



Construction on the Ventura Freeway in the City of Ventura. The view is westward.



In conclusion, these economic influences are not limited to the District VII area. A study of reports from other areas in the United States all indicate the same economic impact. Through a reduction in time and operating costs for motor transport and individuals, the growth and economic stature of an area is increased by an adequate system of modern freeways.

Route Adoptions

The District VII freeway route planning program is presently being accelerated in anticipation of the continually increasing District VII right-of-way and construction budget and to facilitate district planning with a larger store of adopted routes.

Portions of four freeway routes were adopted during 1961 totaling approximately 25.6 miles and an estimated right-of-way and construction cost of $75,000,000.

A total of eight public hearings were held in 1961, and Highway Commission hearings were held for portions of the Antelope Valley Freeway and Newport Freeway adopted in 1961.

The Highway Commission adopted a 36.3-mile section of the Lancaster Freeway from the Golden State Freeway to the Antelope Valley (estimated to cost $17,000,000) on January 25, 1962, and has just adopted (March 28) a 13.6-mile section of the Simi Valley Freeway across Santa Susana Pass between Madera Road in Ventura County and Mason Avenue in Los Angeles, estimated to cost $29,600,000.

A California Highway Commission hearing was held on 5.8 miles of the Foothill Freeway through Pasadena on March 27, 1962.



The San Diego-Harbor Freeway Interchange. The view is south along the Harbor Freeway.

Route location studies are in progress on 373 miles of unadopted interstate and noninterstate freeways in District VII, representing an ultimate cost of approximately $1,610,000,000.

Construction

During the calendar year of 1961 the district witnessed a period of strongest growth in construction to date. Dollar value of contracts increased from the $180,000,000 set in January to over the $250,000,000 mark in November. (In February, 1962, $251,841,930 was the value of going contracts.) These contracts consisted of freeway work, regular highway work, bridge construction, roadside development, signalization and channelization, federal aid secondary projects, maintenance stations, minor contracts and state park contracts administered by the Division of Highways. During 1961, 148 contracts were awarded for a value of $128,290,000. Of the awarded work, $101,500,000 was for freeways; 121 jobs were completed at a value of $46,581,000, a net gain of 27 jobs over the previous year.

Median Barriers

Installation of chain-link and metal beam median barriers designed to prevent head-on collisions was increased during the year, with much of the work being done on already completed and opened freeways. The work of installing the barriers in narrow medians under high speed traffic presents a difficult problem.

However, at the end of the year approximately 33 miles of median barriers on freeways were completed and an added 42 miles were under construction at a cost of $3,185,000. (See "Barrier Report," *California Highways and Public Works,* September-October, 1961.)

As more median barriers are being erected on District VII freeways, repair costs are mounting proportionately. In fiscal 1959-60 the total cost of repairs was $232,959, of which $145,591 or 62 percent was collectable or collected; in 1960-61 cost of repairs was $280,764, of which $167,197 or 60 percent was collectable or collected from the vehicle owners responsible. Thus, losses to the State over two previous years have amounted to more than $200,000. Any monetary losses,

of course, are more than offset by the human factor of the lives saved through the installation of the protective median barrier fences between opposing streams of traffic on our heavily traveled freeways.

Special Studies

In 1961 the District VII Traffic Department completed a joint study with the University of California's Institute of Traffic and Transportation Engineering to develop several techniques for field and office investigation of traffic on freeways.

License plate methods, including dictation into portable tape and wire recorders and high-speed photography, were used to determine travel time and flow percentages on the westbound Santa Ana Freeway between the San Bernardino Freeway Interchange and the 4-Level Structure. Speeds and headways were measured and volume counts taken.

A mailing questionnaire was used to establish surface street paths the drivers took to get to certain onramps of the network. A response of 60 percent of the original mailing of 400 indicated that this particular technique of obtaining the names and addresses of the registered owners for origin and destination questioning was quite effective. The technique has been used since on a much larger scale as a result of the study.

Traffic Counts

Beginning on January 1, 1961, a new state-wide traffic census program was innovated. Traffic volumes after that date were measured fully automatically as opposed to the former mid-July manual count.

Operations section personnel operate 35 control stations, which are counted seven days each month to establish flow patterns on the various state highways in the district. Associated with these stations are approximately 2,700 satellite or profile stations, which are counted for one day only; these data, when correlated with control data, will provide daily traffic flow profiles on all state highways in the district. Utilized for recording control data is a new recorder, which produces raw count data on punch tape for translation onto punch cards required for computer analysis.



Looking south at construction on the Harbor Freeway toward the Pacific Coast Highway. The diagonal road to the left is Sepulveda Boulevard.

For an even more sophisticated approach to measuring traffic volumes on high-speed, high-volume freeways, four permanent stations are operative which use ultra-sonic principles for vehicle detection. Located on the Hollywood, Harbor, Santa Ana and San Bernardino Freeways, ultrasonic sound waves are transmitted and received by detector heads placed over each freeway lane; electronic devices relay this data to the punch tape records providing high counting accuracies.

Also of interest, the district has been conducting a testing program of a new device for multilane traffic detection whose principle is electrical impulses. This is a surface or subsurface installed flat strip containing electric components encapsulated in a plastic compound. By intricate arrangement of components, it is possible to count traffic by individual lane with almost complete accuracy and the values can be recorded by many types of terminal equipment

1961 Average Daily Traffic

Hollywood Freeway (westerly of four-level structure)	195,000
Pasadena Freeway (Elysian Park)	120,000
Santa Ana Freeway (@ Long Beach Freeway)	155,000
San Bernardino Freeway (@ Long Beach Freeway)	125,000
Harbor Freeway (@ four-level structure southerly)	200,000
Colorado Freeway (@ Linda Vista)	24,000
Long Beach Freeway (@ Pacific Coast Highway)	62,000
Using four-level structure	343,000
San Diego Freeway (@ Olympic Blvd.)	72,000
Golden State Freeway (@ Los Angeles River)	85,000
Ventura Freeway (@ San Diego Freeway)	75,000



The Elysian Viaduct on the Golden State Freeway where it crosses the Pasadena Freeway (foreground).

as total volume or by various lane combinations. The product has apparent revolutionary concepts in traffic counting and speed measurement and when fully tested may be widely adopted for traffic counting.

"LARTS" Study

The *Los Angeles Regional Transportation Study* in 1961 made significant progress in developing the information which can be used by State and local agencies in planning for the movement of people and goods throughout the greater Los Angeles area.

Determination of the 1960 average daily traffic and average speeds on the 7,000-mile network of freeways, ma-

STATUS OF DISTRICT VII FREEWAY PROJECTS

Summary as of December 31, 1961

Name of freeway	Route number	Total miles		Completed projects				Under construction			Total obligated cost to date
				Freeway		Expressway		Freeway			
		Planned	Adopted	Miles	Cost	Miles	Cost	Miles	Estimated cost	Right of way cost	
Antelope Valley	23	54.6	54.6		60	0.3	450	14.9	14,791	1,238	16,539
Artesia	175	21.6	18.9		844	4.9	2,324			8,502	11,670
Colorado	161	8.3	7.8	2.3	6,325					2,465	8,790
Corona	77, 240	9.7	4.4			3.2	837			231	1,068
Corona Del Mar	184	6.3	6.3			2.2	215			132	347
Foothill	157, 9, 190	52.7	34.2	2.3	2,409					8,448	10,857
Garden Grove	179	15.4	15.4		1,922					9,630	11,552
Glendale	162, 61, 266	21.8	3.2	1.1	2,914			1.3	3,156	6,798	12,868
Golden State	4, 161	73.2	73.2	17.6	40,057	43.6	6,901	12.0	36,602	70,043	153,603
Harbor	165	22.6	22.6	17.7	42,902			4.5	7,459	52,923	103,284
Hollywood	2, 159	17.3	17.3	10.9	33,946			0.7	2,952	35,578	72,476
Laguna	185	9.4	8.4				570			138	708
Long Beach	167	26.2	21.5	19.7	32,931				22	23,172	56,125
Marina	60	2.6	2.6							180	180
Newport	43	17.7	17.7			3.3	1,772	6.6	8,581	9,513	19,866
Ojai	138	8.2	6.0	2.7	1,360	0.9	376	0.3	909	1,862	4,507
Orange	19, 273	26.9	16.6							3,183	3,183
Pacific Coast	60	112.1	24.3	7.9	3,099					2,831	5,930
Pasadena	165, 205	8.2	8.2	8.2	11,151				1,125	1,291	13,567
Pomona	172, 19	30.0	30.0		45					15,692	15,737
Riverside	175, 43	19.1	19.1	5.7	6,248	13.4	3,920		42	4,939	15,149
San Bernardino	26	30.6	30.6	30.6	43,664				400	18,258	62,322
San Diego	2, 158	93.6	93.6	29.4	42,363			25.7	85,226	92,756	220,345
San Gabriel River	170	29.7	22.6		246					25,007	25,253
Santa Ana	2, 174, 166	42.8	42.8	42.8	55,015				1,331	19,400	75,746
Santa Monica	173, 60	17.1	17.1	1.8	21,048			3.0	25,697	82,345	129,090
Seaside	167	6.8	2.2					1.6	15,683	1,358	17,041
Slauson	221	19.6	0.6								
Ventura	161, 2	75.1	75.1	24.9	34,741	29.7	7,790	12.4	27,656	44,477	114,664
Yorba Linda	176	13.0	3.1							964	964
Route 79	79	51.1	20.6					5.1	4,159	3,568	7,727
Other freeways		398.9									
Totals		1,342.2	720.6	225.6	383,290	101.5	25,155	88.1	235,791	546,922	1,191,158

(COST IN $1,000)

ior arterials and collector roads in the five county LARTS study area is complete.

Five origin and destination studies have been completed and are in various stages of machine processing. Several other origin and destination surveys were conducted in 1961 to determine the travel characterictics of special traffic generators such as shopping centers, Disneyland, Marineland, supermarkets, Los Angeles County Fair and the Newport Beach area. A previous origin and destination survey at Los Angeles International Airport has been recoded to LARTS zones.

A land use survey, which includes an inventory of 1960 land uses in each LARTS zone, is in progress and should be completed shortly.

A floor area study of all buildings three stories and higher in non-residential use is now in progress. (See "L.A.R.T.S. Study," *California Highways and Public Works*, January-February, 1961.)

Conclusion

The three counties of Los Angeles, Orange and Ventura, together forming District VII of the State Division of Highways, are an area of progressive growth and expansion. December 31, 1961 figures indicate 102 incorporated cities inside the District with an aggregate population of 5,878,089, which is an increase of three cities within the past year and an increase in population of 151,669 or 2.6 percent. The total population of the District, including incorporated and unincorporated areas, is 7,379,000, with a motor vehicle registration of 3,978,700. These same statistics for the previous year were 6,942,000 population and 3,840,000 motor vehicle registration.

The District VII annual freeway-highway budget drafted by the California Highway Commission has been in the $160,000,000 range for the last two fiscal years. The announced 1961-62 budget was $157,500,000, the current 1962-63 budget $163,000,000. Maintaining this level of financing on a year by year basis without any ap-

. . . Continued on page 69

Record Sampling

Highway Testing Program Checks Structural Sections

By LYMAN R. GILLIS, Assistant State Highway Engineer

Prior to the inauguration of the record sampling and testing program, it was generally accepted that roadbed structural layers were being placed within reasonable limits of planned amounts. This deduction was based upon the observed performance of control methods and apparent capabilities of the equipment being used.

In 1959 a limited program of record sampling and testing was initiated in California on an experimental basis to learn more of completed roadway structural sections. This program of record sampling and testing was expanded as a cooperative program with the Bureau of Public Roads to include all grading and paving projects completed after January 1, 1960. The record sampling and testing of the samples has been done by the Materials and Research Department on all major projects including FAS projects, and the results of these samples are charted in Headquarters Construction office.

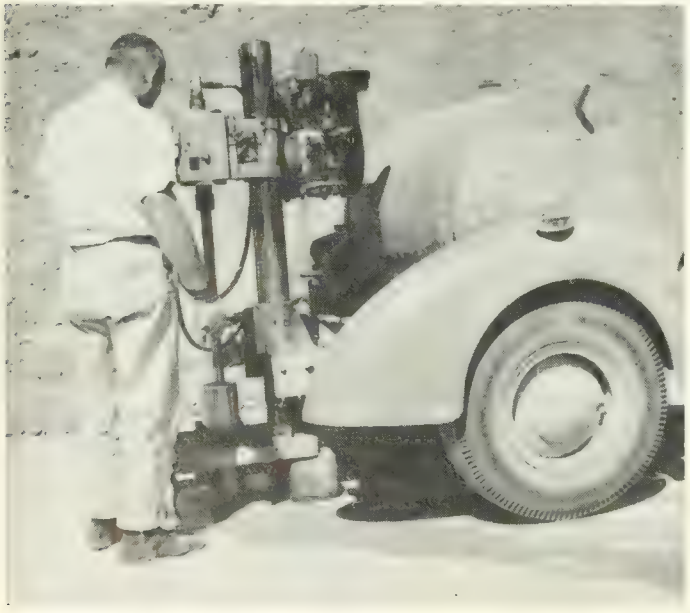
Variations Greater

After obtaining the results of a group of the tests made at the beginning of the current program, it became apparent that the variations reported were greater than had been generally believed were being obtained. With the additional knowledge gained through the record testing program conducted to date, and the efforts made by the state engineers with the cooperation of the contractors, a definite improvement has taken place. Current test results demonstrate that most projects are showing minor variations which are reasonable and practical with the equipment currently in predominant use.

During the period from June 1960 until the present, there have been new methods developed for construction of highways and, after short experimental stages, the product of a majority of these new processes have been accepted by the construction industry and the contracting agency. The new specifications which became effective January 1960 included new controls for placing of both treated and untreated bases and also required more stringent controls on other construction items.

As has been experienced in the past, in order to succeed in the highly competitive field of highway construction, the contractor is always seeking new methods and equipment which will permit increased production rates without increasing his costs. The equipment industry is called upon to develop or furnish equipment which will not only permit increased production, but will encourage adoption of new methods and materials to permit production beyond those required for balance of costs.

The contracting agency in the meantime is requiring conformance with specifications. Contract specifications must be written to allow the use of new methods and equipment that will produce the desired results if

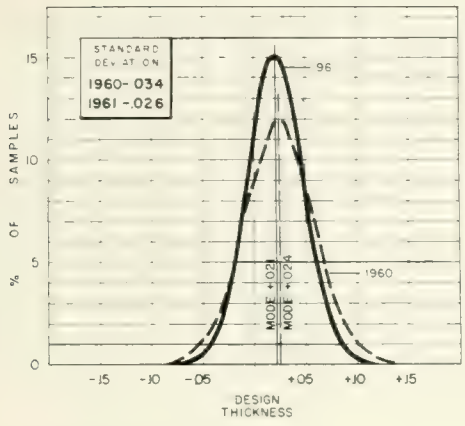


A closeup of the drilling machine used to cut cores through completed concrete pavement in order to measure layer thickness.

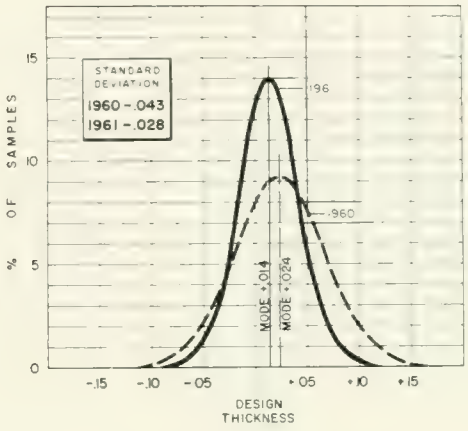


A hole cut in the completed lower portion of the structural section prior to placing the P.C.C. surfacing layer. The hole exposes the planes between each structural layer from which the layer thicknesses are measured.

SURFACE

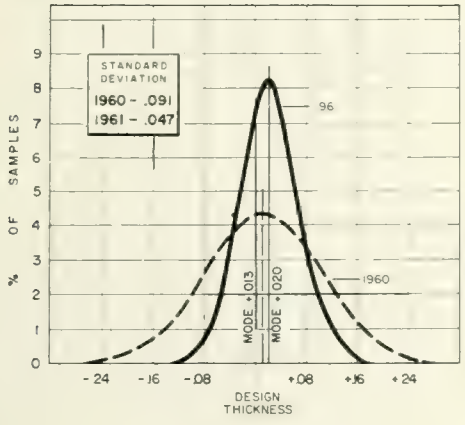


Portland Cement Concrete

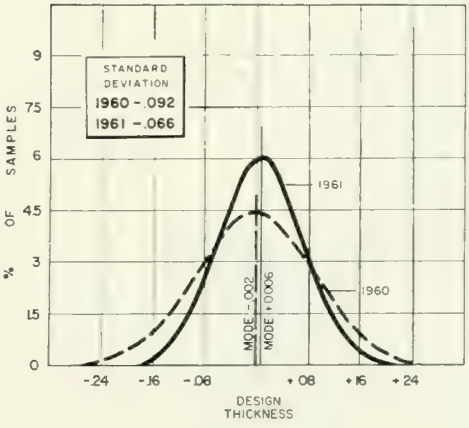


Asphalt Concrete

BASE

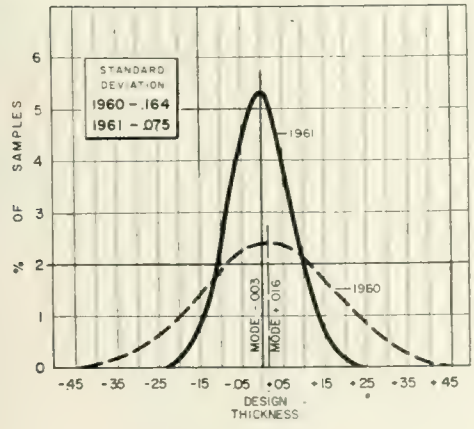


Under P.C.C.

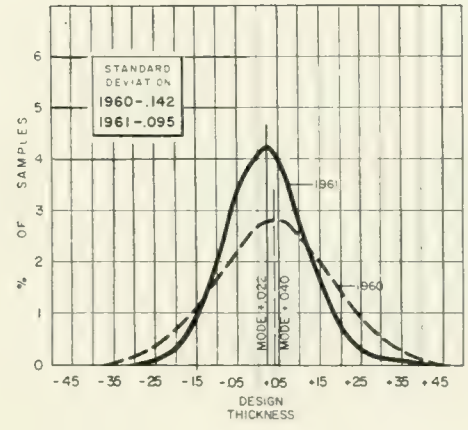


Under A.C.

SUBBASE



Under P.C.C.



Under A.C.

progress is to be made in highway construction without forcing contract prices to increase.

New Equipment Adopted

As a result of these incentives, new equipment has been adopted on state contracts for spreading untreated base material and for mixing and spreading treated base materials. New methods and equipment have been used on placing pavement, both asphalt concrete and portland cement concrete. All of these have been placed in operation and their product accepted since the 1960 Standard Specifications have been effective.

In order to gain a visual concept of the degree of improvement realized by these improved techniques and equipment, the accompanying bell-shaped or, theoretically, normal frequency distribution curves, have been developed from the record sampling and testing results obtained in 1960 and compared with those taken through September 1961.

The many measurements made upon the completed structural sections were tabulated in a manner to give the number of measurements in each .01′ increment of variation from the planned amount for each structural layer. The number in each increment was then reduced to a percent of the total samples for the particular period and structural layer under consideration. From these actual data reduced to a percent of the total, the "normal" or theoretical frequency distribution curve was mathematically fitted to the actual data resulting in the curves shown. In this manner, all curves are reduced to a so-called common denominator and a uniform pattern so that any curve may be compared to all other curves on an equal basis.

Measured Variation Indicated

The interval shown on the horizontal or X axis indicates the measured variation from the planned amount. For example, where in a particular project the measurement reported for a particular structural layer was exactly equal to the planned amount, the variation would be recorded as 0.00′, whereas if a particular structural layer measurement was reported as being 0.55′ while the planned amount for the same structural layer was 0.50′, the variation is indicated as being +0.05′.

The vertical or Y axis represents the magnitude of the number of samples expressed as a percent of the total for the period and layer involved for each increment of variation. In order to judge the relative degree of improvement, an optimum condition would be a condition where all or 100 percent of the measurements were exactly as planned, in which case all points would lie along the line extending vertically from the 0.00′ interval on the horizontal axis, and the vertical line would extend to the 100 percent point on the vertical axis.

The mode is the value of the interval upon which the greatest number of samples fall. This value is reported for each comparison period and structural layer presented in the graphs. As the mode approaches the 0.00′ ordinate or optimum condition on the horizontal axis, it indicates that more samples are being measured closer to the planned amount.

Standard Deviation Presented

In addition to the mode, the standard deviation is presented for each curve. The standard deviation is a mathematical measure of the average deviation from the mean. In curves showing a normal distribution, such as those presented here, the mode is equal to the mean. If a distance equal to the standard deviation is measured from both sides of the mean along the horizontal axis, approximately 68 percent of the samples will be within these limits. As the standard deviation becomes smaller then it indicates that the variation between samples is smaller. Another way of describing the significance of the standard deviation is that as the value of the standard deviation becomes smaller, it indicates that the samples are being grouped closer to the mean.

Each graph presents a dashed line curve based upon data obtained in 1960 with a solid line curve superimposed on it based upon data obtained in 1961. Separate *groups* of charts are presented for the asphalt concrete structural sections and for portland cement concrete structural sections with each group showing the variations from planned thickness for the surfacing, base, and subbase layers. For ease in comparing the same relative layer of the structural section, the graphs are arranged so that the thickness of the asphalt concrete surfacing may be compared with the thickness of the portland cement concrete surfacing; thickness of base under asphalt concrete pavement with thickness of base under portland cement concrete pavement; and thickness of subbase under asphalt concrete with thickness of subbase under portland cement concrete.

Reader May Confirm

With this brief background of the meaning of the charts, the reader may confirm the following evaluation of the record test results. An examination of the various charts presented indicates that the samples taken in 1961 in every case showed improvements over those taken in 1960. This is evidenced by the mean or mode approaching the optimum ordinate of zero variation from the planned amount. It will be noted that this improvement is evidenced for each of the 1961 layers. In addition, the standard deviation for 1961 is less than that computed for samples taken in 1960, indicating less variability in each case. This indicates a condition of improvement along not one, but two phases of the operation, namely that the planned amount is being approached and it is being approached with less variation between samples.

The above evaluation can only result in the conclusion that improvement is being achieved in the production control phase of construction. Improvement of this nature can only be the result of the combined co-operative efforts of both the contractors and state construction personnel.

Through this research and combined effort a measure has been obtained of practical thickness tolerances which are consistent with available equipment and developed methods.

The resulting knowledge of practical tolerances will assist in preventing thickness deficiencies in base and surfacing and will provide a better basis for structural design.

Extra Lanes

Passing, Chain Control Areas On US 50 Prove Their Worth

By DAVID E. CURRIER, Resident Engineer



A total four miles of new four-lane chain control and truck passing sections completed last summer on US 50 in central and eastern El Dorado County proved their worth this winter in expediting traffic during the heavy snow season.

The six locations are shown on the two accompanying maps.

The route between Placerville and Lake Tahoe, adopted in 1895 as California's first section of state highway, traverses the Sierra Nevada range and is heavily traveled by trucks (14½ percent of total volume), both interstate transports and local logging and timber rigs operating in the surrounding forests.

Also, the increasing development of subdivisions and recreational facilities in the Echo Summit-Lake Tahoe region has made it a major year-round residential and vacation area—resulting in growing traffic volumes which are especially heavy on weekends.

Between Placerville and Nevada, a distance of about 63 miles, US 50 is mainly two-lane conventional highway of inadequate width and minimum shoulders. Exceptions are the stretches from Placerville to east of Camino and from Pollock Pines to Riverton which are four-lane expressways. Funds for any extensive freeway construction are not considered imminent.

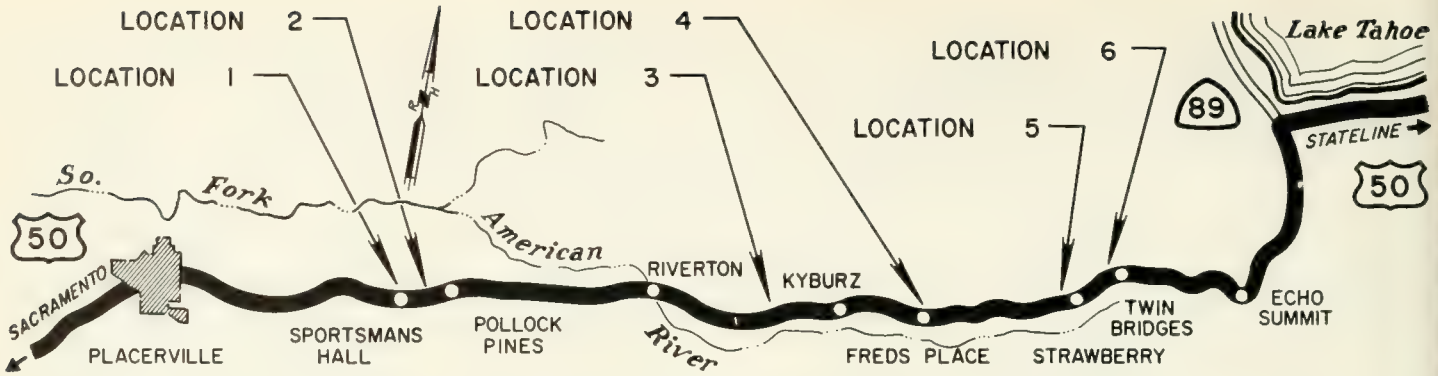
Route Elevations

From the 2,000-foot elevation at Placerville, the route climbs to about 3,700 feet at Sportsmans Hall and peaks at around 4,200 feet a short distance east of Pollock Pines. The descent to Riverton takes motorists to about 3,200 feet where the road crosses the south fork of the American River and begins climbing to Kyburz at 4,100 feet. From there it is a continual upgrade to approximately 6,200 feet at Twin Bridges. Further east is the top of Echo Summit at 7,377 feet.

The result of the two peaks and intervening valley is that the snowline is sometimes such that chains are necessary to negotiate the climb in the Sportsmans Hall-Fresh Pond area, yet there will be tractionable pavement on the approximately 15 miles to Kyburz where chains will be again required.

The eastbound chain control lane on US 50 at Strawberry during a snowstorm on February 6.





The new widened sections of US 50 between Sacramento and Lake Tahoe are indicated on the above map. Locations 1, 2 and 5 are chain control areas; Locations 3, 4 and 6 are passing lane areas.

Another result is the larger number of chaining areas than ordinarily would be found along a route of this length and elevation.

The six new facilities extend and widen previous chain control and passing lanes which had become inadequate due to the increased traffic.

Because of the insufficient length and width of these former chaining lanes, cars often parked on the highway itself, causing hazardous situations. The new lanes range from 1,700 to 2,100 feet with widths the same as passing lanes. During snowfree months these can also be used as turnouts for trucks and other slow-moving vehicles. Shorter chain changing lanes still exist at four other locations.

Former Lanes Inadequate

The former passing lanes were short three-lane sections which became inadequate to speed up the long slow-moving queues of cars that formed behind trucks and trailered vehicles on some of the sustained grades along the route. Each year it was taking longer and longer to drive across El Dorado County, both in summer and winter.



A portion of the Twin Bridges passing lanes being used as a chaining area for the climb over Echo Summit. The cars are headed east.

These passing lanes now range from 4,200 to 4,900 feet in length and permit passing for both eastbound and westbound traffic simultaneously. In effect, each new section provides nearly a mile of four-lane highway with excellent vertical and horizontal sight distance.

In addition to eliminating much of the former congestion, providing safer parking areas for mounting and removing chains, and lessening the driving time between Placerville and Lake Tahoe, the improved facilities will also reduce maintenance costs at Twin Bridges.

Formerly there was a vertical cut through a rock outcropping about 250 feet in length and averaging 20 to 28 feet in depth. During snowstorms wind would funnel through the cut, piling up extremely heavy drifts which closed the road. Rotary plows were useless because the vertical cut permitted no throw space. The drifts had to be repeatedly removed by tedious and time-consuming push plowing with truck-mounted blades and motorgraders. Widening the cut and flattening the slopes by extensive blasting now allows rotary snow removal, freeing personnel and equipment for other troublesome areas.

Structural Section

In general the structural section of the widened areas consists of three inches of asphaltic concrete on a lime-treated base which is eight inches deep under passing lanes and six inches under chain control lanes. At the same time, the existing highway was given a one- to three-inch blanket for the length of each location.

The use of lime-treated base on a heavily traveled highway is unusual in District III and was done on an experimental basis. Lime was added to dry aggregate in the proportion of five per cent by weight of dry material, and mixed in one layer for the six-inch sections and in two layers for the eight-inch depth. Prior to surfacing, the base was primed with SC-2 at the rate of 0.25 to 0.35 of a gallon per square yard with good penetration.

The lime was spread using a modified asphaltic concrete spreaderbox chained beneath bottom-dump trucks and dragged along the grade. This proved to be an unsatisfactory technique for several reasons: The grade had to be compacted before the box could be pulled over it. Once it started, the lime had a tendency to flow like water, spilling over the box to the extent that the amount of lime spread depended on the speed of the truck, the gate opening, and the setting on the box.

Spreading Control Needed

A more positive control of spreading rate needs to be developed, perhaps similar to the augering method used for cement. The modified spreader box was used because it was discovered that it takes an excessive amount of time to transfer lime through a standard eight-inch cement bazooka to a distributor truck, apparently due to its lighter weight (35 pounds per cubic foot) and other physical properties.

After the lime had been spread, the base was scarified and shaped into one or more windrows which were mixed with a Woods-Pettibone Model 54 Mixer. Water was added at the mixer in the amount normally required for optimum moisture. However, compaction was very difficult until more water was added. The treated material was bladed to one side and compacted in thin lifts by pneumatic, segmented, and vibratory type rollers. None was successful when the material contained normal optimum moisture. All were successful when additional moisture was introduced into the treated material.

The contractor found it difficult to mix the full depth in some areas due to inadequate scarifying and it was necessary to remix. Where this was required, the treated base broke out in good sized chunks which had to be crushed with a 26-ton segmented wheel roller.



Looking west at passing lanes at Location 6 near Twin Bridges. The photo was taken at the beginning of February before the heavy snows began. By mid-March the snow pack here was 49 inches.

Samples Tested

Samples of lime were taken from each truck to be tested at the jobsite the first day and at the Sacramento materials lab on following days to check for the specified 85 per cent minimum of calcium hydroxide. All tests were satisfactory with the average above 90 per cent.

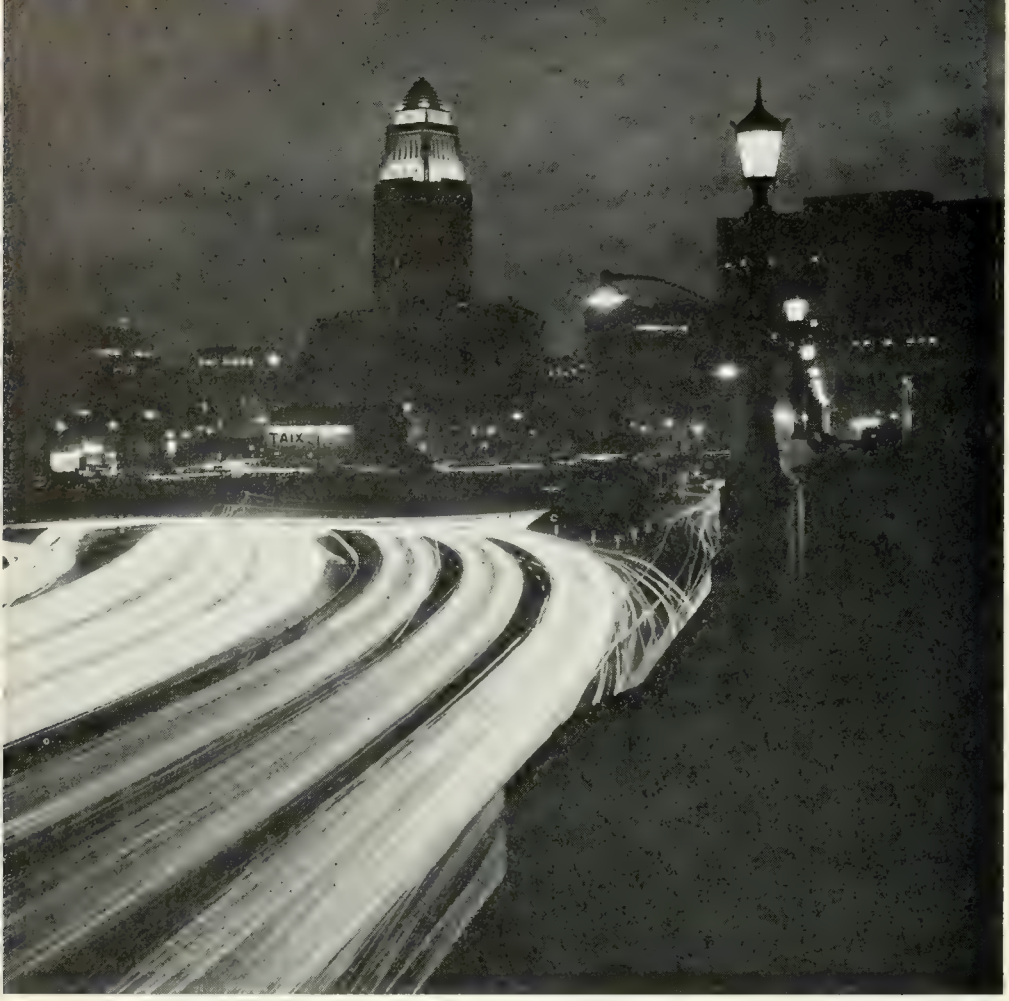
Depth of lime treatment was checked by dribbling phenolphthalein down the sides of test holes. The solution turns red in contact with lime; otherwise it is colorless. This test worked very well.

Because of the great distance (31 miles) from one end of the project to the other and due to the high traffic volumes, the contractor experienced some difficulty in maintaining a balanced operation and production rates were low. However, this was anticipated because of hazardous blasting conditions, heavy traffic problems with time lost in equipment delays, the scattered locations, and the mountainous location of the project. And it was reflected in higher than usual unit prices.

The contract was done as a joint venture of I. L. Croft & Son, Inc., and Union Construction of California, of Saugus, at a cost of $510,000.

TUNNEL 40% COMPLETE

The Division of San Francisco Bay Toll Crossings reported that in March the lowering of the upper deck pavement through the Yerba Buena Tunnel of the San Francisco-Oakland Bay Bridge was 40 percent complete. The Division had five contracts of a total value of $23,087,441 under way in the project to convert the bridge to one-way traffic on each deck.



14th I.T.T.E. Meet

Stresses Urban Problems

THE EVER-INCREASING problem of the city, and what to do about transporting its people and goods, was echoed in the addresses of speaker after speaker at the Fourteenth California Street and Highway Conference this year.

Hundreds of state, county and city traffic engineers, as well as representatives of many private organizations, attended the three-day meeting January 25-27, on the University of California at Los Angeles campus. The meeting was sponsored by the Institute on Transportation and Traffic Engineering and the University Extension, University of California.

Many Well Known Speakers

Speakers included Rex M. Whitton, Federal Highway Administrator; State Senator Randolph Collier, Chairman of the Transportation Committee; State Assemblyman Jack Beaver, Chairman of the Assembly Transportation and Commerce Committee; Douglas J. Carroll, Jr., Direcor, Chicago Transportation Study; Richard Zettel, Research Economist, I.T.T.E.; Joseph E. Havenner, General Manager, Automobile Club of Southern California; Carl Fritts, Vice President, Automobile Safety Foundation, Washington, D.C.; Ellis L. Armstrong, President, Better Highways Information Bureau, Washington, D.C.; and Captain Joseph A. McHenry, U.S. Navy, retired, Assistant Vice President of J. H. Pomeroy & Co., Inc. Many city, county, and state engineers presented papers in the various discussion groups held during the afternoon sessions.

In the opening address, Mr. Whitton spoke on Highway Transportation Planning, but generally confined his talk to aspects of such planning in urban areas. Speaking of the current tendency to blame our urban transportation problems on the automobile, Mr. Whitton said:

"If I were going to try to fix the blame for what has happened in our cities, I'd be inclined to pin it not on the Duryea Brothers, who built the first automobile in 1893, but on Elisha Graves Otis. In case you don't recognize that name, Otis built the first passenger elevator, in New York City back in 1857. He is the man who launched the vertical transportation system which made high-rise buildings practical. I conclude then, that the elevator is responsible for urban congestion.

"Now this may seem a little silly to you, but it's no worse than blaming the automobile. For better or worse, the elevator has helped to change our way of life and it is obviously here to stay . . .

Automobile Here to Stay

"I'm satisfied that the automobile is also here to stay," Mr. Whitten said, "and we must plan accordingly . . . Our urban areas—and our highways—have grown like Topsy, in many cases, without guidance or pattern. It is cer-


LA
TAIX



This model shows the distribution of the 10,212,000 person trips made in the Chicago study area on an average work day in 1956. The highest blocks represent 144,000 trip destinations per quarter square mile grid, the lowest blocks 5,000, the shaded areas less than 5,000 but more than 2,500.

tain that they are going to keep on growing . . . Highway planning obviously must be a part of broader transportation planning, which in turn must be a part of general planning of the urban area as a whole.

"This is not primarily an area for isolated, ivory-tower research, however," Mr. Whitton stated. "The cities and their people are necessarily our laboratories.

"At the risk of belaboring the obvious, I reiterate that co-operation is going to be the foundation of any success we may achieve in planning and in putting that planning to use. All who are concerned must put aside emotional attitudes and snap judgments. Only through harmony, mutual respect, acceptance and use of real and unvarnished facts, and also the willingness to make honest compromises, can we hope to attain success . . ."

Senator Collier reviewed legislation of recent years, and said that three major goals had been accomplished: (1) modernization of the Mayo formula (for distribution of state highway construction funds) should be satisfactory for a long time to come; (2) establishment of a State Highway Transportation Agency (although the Senator would have preferred a *transportation* agency he said) and (3) passage of Senate Bill 1217 which provides $100,000 for highway safety research.

"From what I have seen," the Senator said, "a thoughtful program is being developed in several promising directions; and the departments involved are working more closely together and with other specialists than ever before.

State Freeway Program

"The magnitude of our state freeway program is staggering," Senator Collier said, "and bears constant repeating—more than 12,000 miles of limited access highways costing more than $10.5 billion and designed to accommodate 17 million vehicles. . . .

"The important thing is that we remember the basic reasoning upon which the program was predicated: First, that a statewide freeway system will provide the best bargain for those who pay the bill—faster, safer, and more economical transportation service. Second, that the establishment of our basic arteries and early acquisition of the necessary rights-of-way will be least disruptive to our economy in the short run and most beneficial in the long run. We cannot allow this program to be interrupted."

The Senator discussed tax legislation and possible tax measures at some length, concluding that the defeated 1961 proposal for financing local roads must be said to be one that would have "added another dull patch to a crazy quilt of intergovernmental fiscal relations in the highway field. A bold new program—one that stirs the imagination – may have a better chance."

Assemblyman Beaver, as Chairman of the Assembly Transportation and Commerce Committee, emphasized the importance to local officials of keeping their Assemblyman informed on road matters. He urged particular attention to educating newly elected representatives on statewide problems.

Los Angeles Regional Transportation Study

On Friday morning, Fritz Zapf, City Engineer of Pasadena, discussed the benefits of the Los Angeles Regional Transportation Study, more commonly called "LARTS," which is being co-ordinated by the California Division of Highways, with co-operation from the Federal Bureau of Public Roads. Participating counties are Ventura, Los Angeles, Orange, San Bernardino, and Riverside, with 110 cities in these counties also participating.

The purpose of the LARTS study is to determine the transportation needs of the area for 1960, 1965, 1970, 1975, and 1980, with some extrapolation into the future beyond 1980. Modern high-speed computers and the latest study techniques are used to analyze and relate the movement of persons and goods to land use.

From this study a land use model will be developed to project and distribute changes in population, employment, and land development. Factors used in arriving at these analyses are distribution of past, present, and proposed land use; employment; population; land costs; topography; and the availability of water, sewers, highways, etc.

Mr. Zapf pointed out that approximately 8 million persons are now living in the area encompassed within

the study, and that by 1980; 15 million people will inhabit the area. There are currently 4 million motor vehicles in the area under study which will increase to about 8 million in 1980. In terms of area and numbers, this transportation study is by far the largest undertaking of its kind in the world.

Continuous Planning Operation

"The study is intended to be a continuous planning operation," Mr. Zapf said, "utilizing new data at regular intervals and leading toward greater refinements of study techniques. The first two-year phase of this study will be oriented primarily toward vehicular travel, including trucking and mass transit. Subsequent phases are planned to include the possibility of other modes of travel and any other likely innovation in the movement of people and goods."

Four basic and immediate uses of the study are (1) furnishing a pattern for the movement of people and goods in the area during the study years; (2) analysis of the vehicular transportation needs on a local and regional basis, as well as daily traffic volumes on freeways, major arterials, and collector streets; (3) evaluations of present and future land use plans, as proposed by local planners in terms of transportation needs; (4) detailed information on population, employment, motor vehicle ownership, etc., plus an inventory of land use for every local community concerned.

The other featured speaker Friday morning was Dr. Douglas J. Carroll, Jr., Director of the Chicago Area Transportation Study.

In the Chicago study much concern has been given to intercity movement which develops at entries to the 30-mile square area. Airports, docks, and railway stations are all considered entries or "gates" to the city.

Special charts of desire lines have been made by a magnetic tape process which gives a very fine white line on the black background for each trip. The result, as Dr. Carroll pointed out, somewhat as though each vehicle had a small light on its top and was photographed at night from several miles above the city with a time exposure. Dr. Carroll showed slides of these charts, also slides of a special three-dimensional model of destination studies which adds a thin layer for each vehicle destined for that spot. When the study is complete, the three-dimensional representation bears a startling resemblance to a city skyline with tall skyscrapers in the city center.

Public Transport

In the Chicago area, public transport handles most of the movement of persons who work in the city's center. This is because Chicago is a relatively old city compared to West Coast cities, and the development of transportation routes in the early days stimulated residential development along their lines. The study shows that this pattern will be about the same in 1980. The great increase in automobile traffic in the same period must be met by development of new high-speed routes with limited access which draw traffic off the city streets where the bulk of deaths and accidents occur.

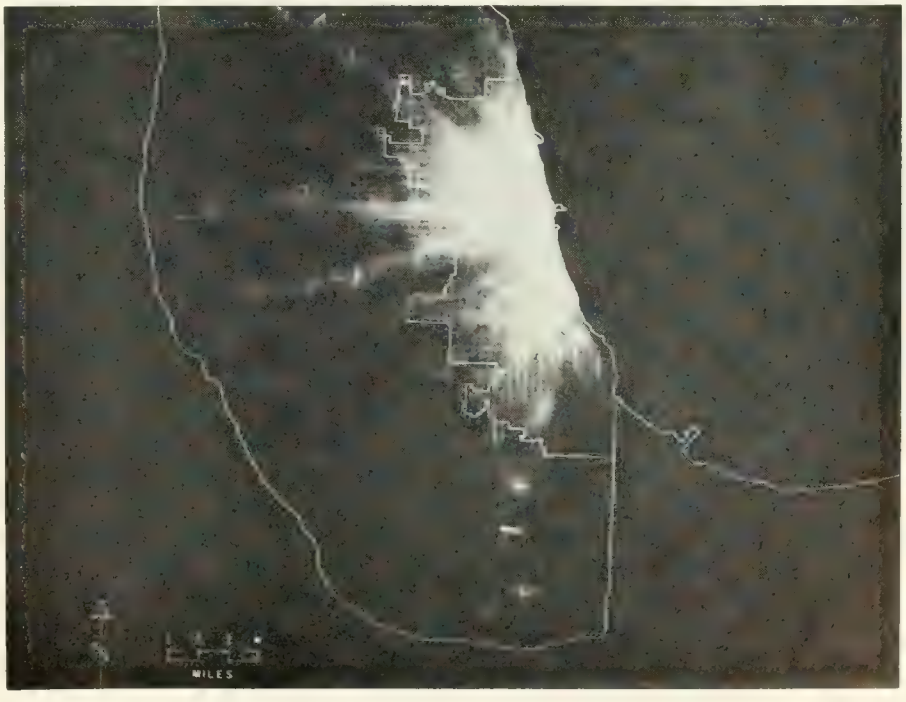
Doctor Richard Zettel, Research Economist of the Institute of Transportation and Traffic Engineering, talked on intercity freight transport which he said was harrassed by extravagant claims and counter claims. One of the dangers that Dr. Zettel fears in urban planning is an increasing tendency toward considering urban freight transport as separate from economic transport.

Piggy Back Loadings

In Dr. Zettel's opinion, the intercity transport of goods will continue to be generally by truck and generally short haul. In this connection, he pointed out that the extravagant estimates a few years back on the potential of "piggy back" freight movement probably would not be realized. Piggy back loadings today are running about 550,000 to 600,000 per year, but this figure may be tapering off, and even now represents less than 2 percent of truck freight movements.

Keynote speaker on Saturday morning was Ellis L. Armstrong, Head, Better Highways Information Bureau, Washington, D.C. Mr. Armstrong's talk was on "Government Controls on Federal-aid Highway Projects." "To survive," Mr. Armstrong said, "a program must be in the public interest, and must advance the basic fundamental goals and progress of the public. No program or service, no method of providing the program or service, or for that matter, no part of our government itself, has an inherent right to be perpetuated unless it is to the public advantage—and unless it is so understood by the public."

This graph summarizes the concentration of average weekly travel by rapid transit, by bus, by automobile drivers and passengers in the Chicago study area.



Highway Week

President Designates May 20-26; Governor Sets State Observance

The week of May 20-26, 1962, will be observed in California and throughout the nation at the second National Highway Week, having been so proclaimed by President John F. Kennedy.

Keynote for California's observance was set by Governor Edmund G. Brown in a statement issued in April (*see adjoining column*).

Organizations interested in the highway program in California, particularly in the southern part of the state, are planning various events to highlight the observance, as was done last year. Emphasis in many areas will be on local highway progress.

District offices of the Division of Highways are co-operating in the observances in various communities.

Text of the President's proclamation follows:

"WHEREAS our Nation, with its expanding economy and growing population, is largely dependent on its highway network for the safe and efficient movement of people and goods; and

"WHEREAS the inadequacies of our present highway network are responsible in large degree for one of the great American tragedies of our time —the costly and inexcusable annual toll of deaths and injuries on the highways; and

"WHEREAS the Congress, at my request, last year made financial provision for completing the finest road network the world has ever seen, geared to our future as well as present needs; and

"WHEREAS the American people should be reminded of their vital interest in this program and the boundless benefits it will produce:

"NOW, THEREFORE, I JOHN F. KENNEDY, President of the United States of America, do hereby proclaim the week of May 20-26, 1962, as National Highway Week in recognition of the vital role of highway transportation in our way of life; and I urge the Governors of the States and mayors of cities to issue similar proclamations.

"I also ask the appropriate officials of the Federal, State, and local governments, as well as public and private organizations and the general public, to join in observance of this significant occasion.

"During this period I encourage all Americans to consider and appreciate the value of highway transportation to their own activities and to our national welfare."

As was the case in 1961, the nationwide effort to observe National Highway Week has been given major impetus by the Better Highways Information Foundation. This is an organization based in Washington, D.C., and interested in the cause of highway improvement.

The B.H.I.F., in literature, posters and radio and television programs, has called attention to the fact that "Better Highways Now—Save Lives, Time and Money" as a theme for National Highway Week this year. Ellis L. Armstrong, former U. S. Commissioner of Public Roads, is president of B.H.I.F.

EDMUND G. BROWN
GOVERNOR

State of California
GOVERNOR'S OFFICE
SACRAMENTO

California's more than 9,000,000 registered motor vehicles make this a highway-minded and highway-oriented state. It is not surprising that we have the finest state network of toll-free, pay-as-we-go modern highways in the nation, with 2,400 miles of divided highway in operation, most of it of the freeway type. We have thousands more miles under construction or on the drawing boards in accordance with a well-established, long-range plan.

The efficient mobility which these freeways give us is gratifying but it is not the whole story. We are building every possible safety feature into them--and they are saving hundreds of lives every year. We make them serve the whole community as well as the motorist. We insist that they be attractive as well as functional.

President Kennedy, in his proclamation of May 20-26, 1962, as National Highway Week, cited the "boundless benefits" our planned road network will produce when it is completed. Californians have already reaped substantial benefits in terms of lives, time and money saved and jobs and opportunity enhanced through the freeways and other modern highways we now have.

As Governor, I encourage all interested groups and individuals in California to take part in the events scheduled in observance of National Highway Week, and especially to take this occasion to inform themselves more fully concerning the progress of our State Highway Program and its importance to our safety and prosperity.

Edmund G. Brown

EDMUND G. BROWN, Governor

HIGGINS LEAVES; BURRILL IS SUCCESSOR

E. Roy Higgins, who has been supervising the fiscal aspects of California's state highway program for the past 31 years, retired from state service on February 28.

Appointed to succeed him is John C. Burrill of San Francisco, who recently terminated a 24-year career as an officer in the U.S. Navy.



E. ROY HIGGINS

Higgins' total length of state service is 40 years. He is a charter member and past president of the California State Employees Association and has been active in a wide range of state and civic affairs in the Sacramento area.



JOHN C. BURRILL

Higgins was born and raised in Healdsburg, Sonoma County, and received his bachelor of arts degree from the University of California in 1919 after serving in the Army in World War I.

His first accounting jobs were with the U.S. Shipping Board and a steamship company. He became an accountant for the State Department of Finance in 1922 and moved to the Department of Public Works as chief accountant in 1928. Three years later has was named comptroller.

At that time the Division of Highways had a total annual budget of about $30,000,000. The division's current annual budget, covering a wide range of functions, is more than $650,000,000. Higgins has had the responsibility for planning, organizing and directing the accounting and other fiscal operations for the division. He has also been responsible for investing available state highway funds in short-term interest-bearing securities, and for administering revenue bond issues of the California Toll Bridge Authority.

Higgins was one of the founders of he California State Employees Association in 1931 and has been active in its affairs ever since, including a term as state president in 1935. He also helped organize the State Employees Credit Union No. 1 in 1932, has continuously been one of its directors, and became its president in 1960 after nine years as vice president.

When the City of Sacramento took over operation of bus service in the area in 1955, Higgins was appointed by the City Council as a member of the new Sacramento Transit Authority. He has since been twice reappointed, and has served a term as chairman.

He has served on the executive board of the Golden Empire Council, Boy Scouts of America, since 1941 and as president of the Golden Empire Council, his service being recognized by the Silver Beaver Award; director for several years of the local United Crusade and its predecessor, the Community Chest; membership on the Sutter Hospital Advisory Committee since 1952; and director of the Sacramento County Appeals Review Board since 1945. He is also treasurer of the Sacramento Council of the Navy League.

Higgins is a member of the Sutter Club (director for three years), University Club, Elks, American Legion, State Men's Club and Sacramento and Fort Sutter Yacht Clubs.

Since 1928 he has been a member of the Uniform Accounting Committee of the American Association of State Highway Officials.

He and his wife Helen live in Sacramento. They have two children, Donald R. Higgins of San Rafael, a senior bridge engineer for the Division of Highways, and Mrs. Shirley J. Black of Walnut Creek; and six grandchildren. A freighter trip around South America is the first item on the Higgins' retirement agenda.

Burrill, Higgins' successor, was a captain in the U.S. Navy Supply Corps, serving with the Western Sea Frontier.

Born and raised in Milwaukee, Burrill was graduated from the U.S. Naval Academy in 1938 and the Naval Supply and Finance School in 1941. He has since held supply, fiscal and other administrative posts in the United States and the Pacific. During World War II he served as purchasing and supply officer at Pearl Harbor, with the Seventh Fleet, and at the U.S. Naval Supply Depot at Brisbane, Australia.

For five years beginning in 1954 Burrill handled interservice purchasing problems for the entire Navy. His assignments for the past year, in San Francisco, have included assistant supply officer for the 12th Naval District and his current duties of transportation officer, assistant logistics officer and interservice supply officer for the Western Sea Frontier.

Burrill is married and has three children. He was senior tennis champion of the Pacific Fleet in 1960.

L.A. AREA FREEWAYS

Continued from page 57 . . .

preciable right-of-way or construction cost increases, will assure the scheduled completion of the California Freeway and Expressway System by 1980, as envisaged by the 1959 California Legislature.

"The California Freeway System and the National System of Interstate and Defense Highways enable Southern Californians to enjoy great mobility, access to a wonderland of recreational areas, and freedom of choice as to the location of work, play, residence and worship.

"California's Freeways are Yours—Use them well, and they will serve you well." — Automobile Club of Southern California.

Including funds already invested, an estimated $4,367,311,000 will be expended on 1,342 miles of freeways within the 1980 planning program in the district. Completion of these routes will give Los Angeles County 904 miles of freeways at a cost of $3,406,-122,000; Ventura County 199 miles at a cost of $291,100,000; and Orange County 239 miles at a cost of $670,-039,000.

U.S. 99 FREEWAY

The State Department of Public Works has awarded a $672,080 contract for converting a 6-mile section of US 99 from expressway to full freeway in Tulare County between Goshen and Traver.

District Staff

Three Named to New Jobs In Districts IV and VII

Appointment of three additional district engineers, two in the Los Angeles District and one in the San Francisco District of the California Division of Highways, has been announced by State Highway Engineer J. C. Womack.

The new appointees, all three promoted from Assistant District Engineer positions in their respective districts, are:

A. C. Birnie, to be District Engineer – Administration, District VII, Los Angeles.



A. C. BIRNIE

A. W. Hoy, to be District Engineer – Design, District VII, Los Angeles.

Haig Ayanian, to be District Engineer–Planning, District IV, San Francisco.

The appointments were effective April 1, 1962.

Increased volume of state highway work in the two major metropolitan areas, including greater emphasis on long-range urban transportation planning, made the additional appointments necessary, Womack said. The changes include some reassignment of top level staff duties, primarily in the fields of planning and design.

The state highway construction budget for the 1962-63 fiscal year, including rights-of-way, amounts to about $163,000,000 in District VII, comprising Los Angeles, Orange and Ventura Counties; and $103,000,000 in District IV, comprising nine counties in the San Francisco Bay area.

The top staff organization in District VII will now include four district engineers reporting to Assistant State Highway Engineer E. T. Telford. G. A. Hill will continue as District Engineer – Planning and A. L. Himelhoch as District Engineer–Operations, in addition to the new assignments given to Birnie and Hoy.

In District IV there will be three district engineers reporting to Assistant State Highway Engineer J. P. Sinclair. R. A. Hayler, who has been District Engineer–Planning, will now be in charge of Design, with Ayanian succeeding to his former title. L. A. Weymouth will continue as District Engineer–Operations.

Birnie, who moves up to the newly-established position of District Engineer–Administration, is a native of Barre, Vermont. He joined the California Division of Highways staff in District IV, San Francisco, in 1947, after 13 years of highway engineering work in his home state and military service in World War II with the Army Engineers.

In District IV he worked on highway planning and location, particularly for freeways in Alameda and Contra Costa Counties, and later on budgets and administration, including personnel and public information duties. In January 1960, he was promoted to Assistant District Engineer –Administration in District VII, Los Angeles.

Birnie is married and has two daughters. He lives in Canoga Park.



A. W. HOY

Hoy, assuming the newly-established duties of District Engineer–Design, has been with the California Division of Highways since shortly after his graduation in civil engineering from the University of Michigan in 1929. He was born and raised in Huntley, Illinois.

His career has covered practically all aspects of highway engineering, but since his return from military service in World War II as a Seabee officer he has concentrated in the fields of traffic engineering, planning and budgets. He was promoted to Assistant District Engineer – Traffic in 1947, transferred to advance planning duties in December 1949, and was placed in charge of programs and budgets in December 1955.

Hoy is a resident of Pasadena. He and his wife have two sons.

Ayanian, District IV's new District Engineer–Planning, has spent most of his California Division of Highways service, which began in 1937, in the construction field. He was born in Niagara Falls, New York, but came to California as a child and attended the University of California at Los Angeles.

His first engineering job, in 1936, was as a surveyor's aid on the Mono Craters Tunnel project of the Los Angeles Department of Water and Power. After joining the Division of Highways the following year he worked in the San Diego and Stockton districts before being assigned to District VII, Los Angeles, in 1940.



HAIG AYANIAN

After returning from World War II service with the Seabees, Ayanian was resident engineer on major freeway contracts near downtown Los Angeles, then served as a construction engineer for the district. In 1956 he was promoted to Assistant District Engineer for District IV, and moved to San Francisco to take charge of that district's construction program.

Ayanian's home is in Millbrae. He is married and has a son and daughter.

NEW L.A. LOOP LINK

A new link in the Los Angeles Freeway Loop has added another mile to the route which heads east to the East Los Angeles Interchange and northwesterly along the Golden State Freeway to Lankershim Boulevard in the San Fernando Valley, a total distance of 23 miles. The combined cost of the 23-mile loop for both rights of way and construction was approximately $183,000,000.

New Routings

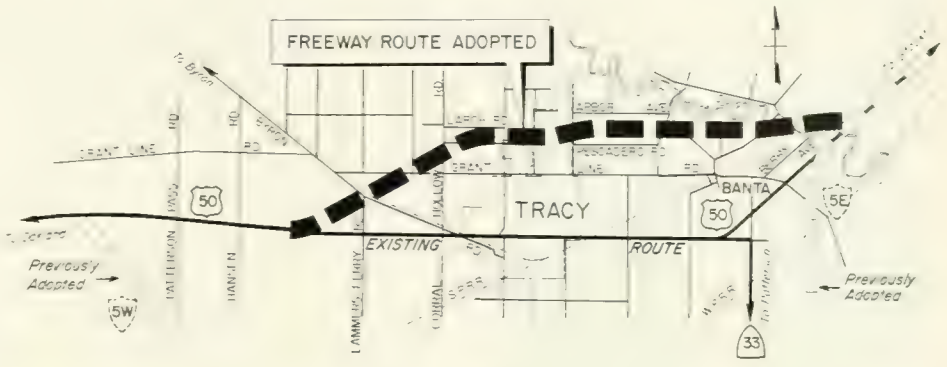
Commission Adopts 13 Freeway, 7 Conventional Highway Routes

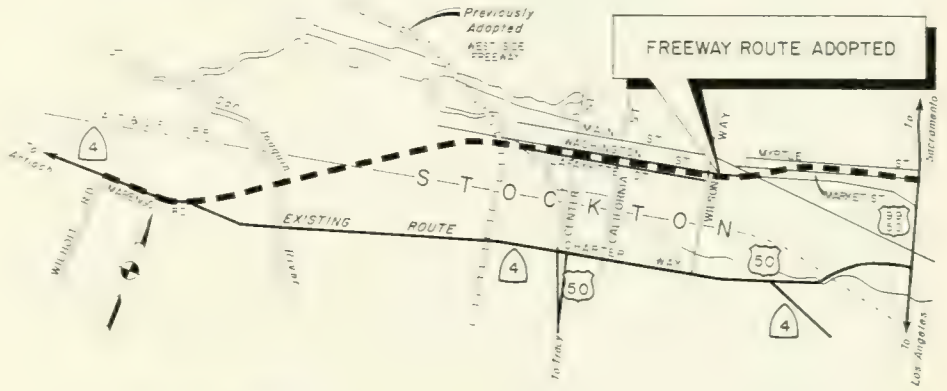
Thirteen freeway routings and seven conventional highway routings for sections of highway throughout the State were adopted by the California Highway Commission at its January and February meetings.

The commission also held a public hearing in Lakeport on Monday, February 19, in connection with its consideration of a freeway routing for six miles of State Sign Route 29 in Lake County between Hopland Road (State Highway Route 16) and the vicinity of Wilkerson Road one mile south of Kelseyville.

One freeway routing adopted was for the relocation of 9.5 miles of U.S. Highway 50 in San Joaquin County between 3.4 miles east of the Alameda County line and the adopted route for the Westside Freeway east of Tracy which follows existing US 50 in that area. The adopted route runs through the northern tip of Tracy.

Another freeway route adopted is for 6.7 miles of State Sign Route 4 in and near Stockton. The adopted route is the "Washington-Lafayette" line recommended by State Highway Engineer J. C. Womack and supported by a Stockton delegation which appeared before the commission in November.



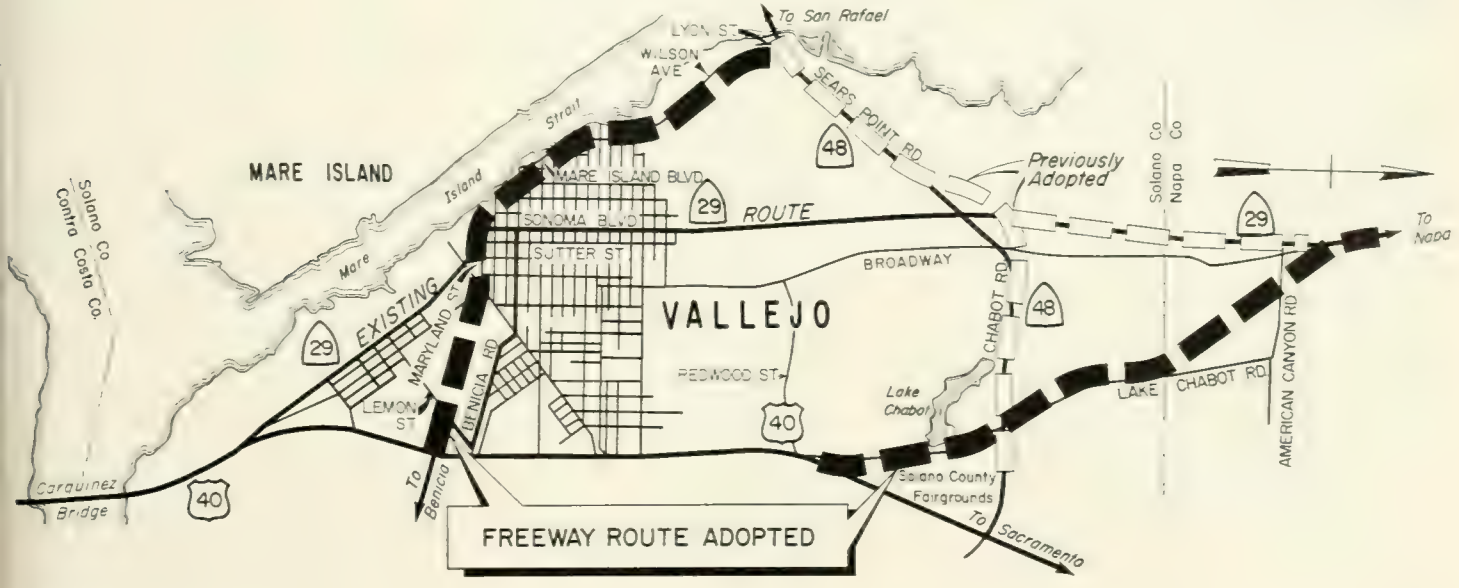


Redwood Highway

In Mendocino County a freeway routing was adopted for the relocation of approximately 20 miles of US 101 (Redwood Highway) between 0.6 mile north of Tan Oak Park and the Humboldt County line. The adopted route follows the general course of the present highway but at a number of locations is on the opposite side of the South Fork of the Eel River from the existing road.

Freeway routings were adopted for two sections of State Highway Route

. . . Continued on next page



State Architect Anson Boyd Retires

Anson Boyd, fifth State Architect since the division was created in 1907 and for 21 years Chief of the Division of Architecture, retired February 21.

Since Boyd's appointment on June 1, 1940, he has supervised the design and construction of facilities totaling over $1 billion, or about 92 percent of all work handled by the division during its 54-year history.



ANSON BOYD

In two decades he developed the division's architectural capacity from a small handful of men doing work amounting to less than $2.75 million a year to an organization of over 1,000 men and women in administration, architecture, engineering, and construction supervision, handling a capital outlay program amounting to about $100 million annually.

Since World War II, 30 new hospital institutions, state college campuses, and correctional institutions have been planned and built under Boyd's supervision.

The facilities of 25 existing institutions have been doubled or tripled in size and capacity. In addition, numerous office buildings, fish hatcheries, armories, and other facilities, including restoration of historic buildings, have been accomplished.

Since 1940 Boyd's Schoolhouse Section staff has checked the plans of 18,950 school projects with a total value of $3.5 billion.

Boyd came to California from New York in 1924. He practiced architecture in Los Angeles, designing buildings in California and Hawaii.

He studied architecture at the University of Pennsylvania under a Sims Memorial Scholarship, and attended the Museum School of Industrial Art in Philadelphia.

In New York he was a designer in the offices of McKim, Mead and White, and York and Sawyer.

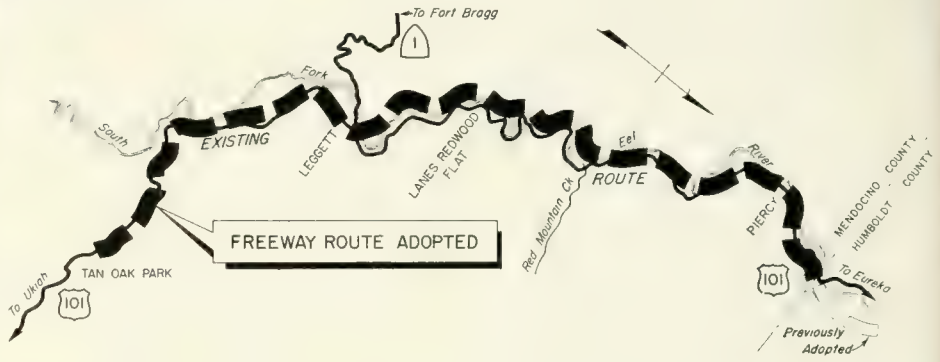
Boyd plans to return to private practice.

Earl W. Hampton, Deputy Chief of the Division (Architecture and Engineering), has been designated Acting State Architect pending the appointment of a successor to Boyd.

NEW ROUTINGS

Continued from page 71 . . .

74 in Solano and Napa Counties in and near Vallejo. One section, 4.2 miles in length, is between State Sign Route 48 (Sears Point Road) near Lyon Street and a junction with U.S. 40 near Lemon Street. The existing highway on this section is designated as Sign Route 29. The other section, 4.1 miles in length, is between Sign Route 29, 1.3 mile north of the Solano-Napa County line near American Canyon Road and U.S. 40 near Redwood Street.



Other freeway route adoptions:

Alpine County—6.4 miles of Sign Route 4-89 between Markleeville and Woodfords.

Calaveras, Alpine Counties—10.4 miles of Sign Route 4 (Ebbetts Pass Highway) between Ganns and 2.8 miles east of the Calaveras-Alpine County line.

Los Angeles County—36 miles of Sign Route 138 between U.S. 99 southeast of Gorman and the adopted freeway route for the Antelope Valley Freeway (U.S. 6) north of Lancaster.

Placer County—4.2 miles of Sign Route 49 between Rock Creek and 0.2 mile south of the Placer-Nevada County line at Bear River.

North of Crestline

San Bernardino County—8.5 miles of State Highway Route 188 between 5.4 miles northerly of Crestline and about three quarters of a mile west of Las Flores Road. (Relocation to be necessary because of construction of the proposed Cedar Springs Reservoir.)

San Diego County—3.4 miles of State Highway Route 279 in the City of San Diego. This is a new route added to the State Highway System in 1959 and is part of the California Freeway and Expressway System. It will provide an east-west connecting highway between a number of existing and planned north-south freeways.

Shasta, Lassen Counties—Feather Lake Road (Sign Route 44) between Sign Route 36 five miles west of Susanville and Sign Route 89 near Old Station.

Solano County—13.5 miles of Sign Route 12 between Denverton and the Sacramento county line (Sacramento River) at Rio Vista.

Tulare County—20.4 miles of Sign Route 65 in Tulare County between Avenue 228 at Lindsay and four miles north of Woodlake.

Conventional highway routes adopted included:

Mendocino County—Relocation of nine-tenths of a mile of Sign Route 1 in the vicinity of Mallo Pass Creek five miles north of Manchester. Will eliminate curves.

San Luis Obispo County—For portions of State Highway Routes 125 and 137 between the Salinas River east of Atascadero and a tenth of a mile west of Huer Huero Creek. The routing follows the Creston-Eureka Road and its adoption is in effect an exchange of roads with San Luis Obispo County.

HOWARD WOOD RETIRES; SWEET APPOINTED

Howard C. Wood, Principal Bridge Engineer in charge of the maintenance and operation of state-owned toll bridges in California, retired March 20, after 32 years of state service.



HOWARD C. WOOD

Wood's successor will be Charles L. Sweet, now Assistant Operations Engineer for the Bridge Department of the State Division of Highways in Sacramento.

The bridges under Wood's jurisdiction include the eight-mile-long San Francisco-Oakland Bay Bridge, the twin Carquinez Bridges, the Richmond-San Rafael Bridge, the San Mateo - Hayward Bridge and the Dumbarton Bridge.



CHARLES L. SWEET

These bridges have come to play a vital role in the highway transportation and traffic picture in the Bay area, carrying more than 62,000,000 vehicles in a single year. The Bay Bridge alone handles 110,000 cars on an average day with some peak daily counts as high as 133,000.

Wood's successor will also have under his charge the maintenance and operation of the Benicia-Martinez Bridge as soon as it is completed later this year.

Wood came to work for the State in 1929 with the Division of Highways in Sacramento. He was a design engineer on the San Francisco-Oakland Bay Bridge from 1931 to 1939. He was appointed a Senior Bridge Engineer in 1933 and assigned to his present position in 1941. He was promoted to Principal Bridge Engineer in 1945.

Wood was born in Danville, Contra Costa County, where he attended grade and high school. He served with the U.S. Army during 1918 after which he went to the University of California at Berkeley where he received his B.S. in civil engineering, graduating with high honors including membership in two honor fraternities, Phi Beta Kappa and Tau Beta Pi.

After graduation he was inspector of construction on the Carquinez Bridge, built as a private toll bridge and purchased by the State in 1951. Later, he was assistant engineer on the construction of the Bucks Creek Power Plant on the Feather River.

Wood and his wife, Bernice, live in Berkeley.

He is a member of the American Society of Civil Engineers, the Commonwealth Club of California, the Pan American Society and Sigma Xi.

Sweet, the new engineer in charge of toll bridges, was born in Bellingham, Washington, and is a graduate of Rensselaer Polytechnic Institute of Troy, N.Y.

He started work with the State Division of Highways in San Diego in 1928 and transferred to the Bridge Department the following year.

From 1931 to 1942 he served as assistant resident and then resident engineer on many bridge construction projects both in Southern and Northern California.

During World War II Sweet was a lieutenant commander with the Navy Seabees.

In 1947 he was appointed construction supervisor for Northern California for the Bridge Department and in 1950 was promoted to supervising bridge engineer in charge of county and co-operative projects. He was appointed Assistant Operations Engineer in 1953.

Sweet is a member of the American Society of Civil Engineers.

He and his wife, Isabelle, live in Sacramento. They have a daughter, Mrs. George Selleck, of North Hollywood.

FREEWAY JOB AWARDED

The State Department of Public Works has awarded a $2,181,642 contract for grading and paving on 5.6 miles of four-lane freeway on US 101 in Mendocino County between Ford Road near Ukiah and one-half mile south of Forsythe Creek.

G. N. Cook Served Five Division Chiefs

George N. Cook, Jr., of Sacramento, administrative assistant to the State Highway Engineer and assistant secretary of the California Highway Commission, retired February 1 after 40 years with the State Division of Highways.



GEORGE N. COOK

Cook first went to work for the division in 1922 as a senior clerk in the highway maintenance department at the Sacramento headquarters. In 1924, he was appointed secretary to then State Highway Engineer R. M. Morton.

He has been secretary or assistant to every state highway engineer since then.

Cook also was appointed Assistant Secretary of the California Highway Commission in 1937.

In this post, he received and processed countless legal documents, special reports, hearing transcripts and other papers, plus the heavy correspondence required in connection with the various commission responsibilities such as the adoption of freeway routes and the budgeting of highway funds.

He has also assisted with arrangements for hundreds of appearances by groups and individuals before the Highway Commission.

A native of Sacramento, Cook graduated from Sacramento High School in 1917 and was in the U.S. Army during World War I.

He is a member of Sacramento Masonic Lodge 40, Post 61 of the American Legion, and the Sacramento Trade Club. He is a charter member of the California State Employees Association.

He is being succeeded in the administrative assistant and assistant secretary posts by Robert T. Martin, former administrative assistant at the Division of Highways District II office in Marysville.

RETIREMENT FOR 89 HIGHWAYS WORKERS

The Division of Highways has announced that the following 89 employees have retired since the previous list which appeared in the September-October, 1961, issue of the magazine:

Headquarters Office

Neil T. Austin, Associate Chemical Testing Engineer, 32 years; Wm. Bock, Supervising Highway Engineer, 41 years; George N. Cook, Administrative Assistant, 38 years; Robert V. Cozier; Highway Engineering Technician I, 15 years; Coral E. Davis, Supervising File Clerk I, 39 years; Herbert S. Marshall, Assistant Highway Engineer, 36 years; Ruth C. Nelson, Calculating Machine Operator, 20 years; Lucy H. Sanchez, Intermediate Clerk, 15 years, James W. Trask, Deputy State Highway Engineer, 33 years; Mary A. Close, Accounting Technician II, 19 years.

District I

George D. Hanson, Highway Maintenance Man II, 26 years; Tollie G. Hinton, Highway Maintenance Man II, 34 years; Ivan G. Lawson, Highway Maintenance Man II, 26 years; Lee R. Redden, Senior Highway Engineer, 39 years; John P. Smith, Highway Maintenance Man III, 32 years; Ernest C. Larsen, Highway Equipment Operator-Laborer, 37 years.

District II

James W. Curlee, Highway Maintenance Man II, 27 years; William H. Easley, Highway Field Office Assistant, 38 years; Guy S. Higgins, Highway Maintenance Man III, 33 years; Harry W. Jerden, Carpenter, 17 years; Harold P. King, Highway Equipment Operator-Laborer, 14 years; Paul K. Miles, Highway Maintenance Man II, 25 years; Herbert H. Prather, Highway Foreman, 33 years; Harry E. Sheffield, Highway Equipment Operator-Laborer, 30 years; Ora E. Smith, Highway Maintenance Man I, 29 years.

District III

James C. Cleek, Highway Maintenance Man I, 27 years; John A. Hardie, Highway Foreman, 39 years; Edward J. O'Donnell, Highway Tree Maintenance Foreman, 23 years; Herbert A. Sale, Highway Foreman, 22 years.

District IV

John G. Barnes, Associate Highway Engineer, 16 years; George L. Beckwith, Senior Highway Engineer, 32 years; James G. Burke, Highway Bridge Maintenance Foreman, 33 years; Cyrus R. Burns, Associate Highway Engineer, 33 years; Reuben E. Freitas, Highway Maintenance Man II, 29 years; Leo Immel, Highway Maintenance Man II, 27 years; Catherine J. Moriarty, Supervising Clerk I, 33 years; Henry A. Simard, Associate Highway Engineer, 39 years; Harold A. Summers, Senior Highway Engineer, 31 years; Wilford W. Coles, Highway Engineering Technician I, 31 years.

District V

Lawrence P. Davis, Associate Highway Engineer, 29 years; Edwin J. Eggler, Highway Foreman, 25 years; Matthew L. Miller, Highway Maintenance Man II, 16 years; Manuel L. Pimentel, Highway Equipment Operator-Laborer, 19 years; Louise D. Waltz, Supervising Stenographer I, 19 years; Claude S. Young, Accounting Technician III, 35 years; Clarence C. Canham, Highway Equipment Operator-Laborer, 31 years.

District VI

Michael J. Gilevich, Highway Foreman, 28 years; Eugene F. Ingham, Highway Maintenance Man III, 15 years; John Lorentzen, Highway Maintenance Man I, 15 years; Oscar O. Miller, Highway Maintenance Man II, 27 years; Harry T. Vinyard, Highway Maintenance Man II, 25 years.

District VII

Rulon W. Garn, Delineator, 32 years; Paul M. Harris, Senior Highway Engineer, 31 years; Dallas C. Locker, Highway Engineering Technician I, 7 years; Alfred P. Lund, Assistant Highway Engineer, 15 years; Roy J. Thurman, Laborer, 17 years; Aaron L. Olmstead, Highway Superintendent, 25 years.

District VIII

Lawrence Cleaver, Highway Equipment Operator-Laborer, 29 years; David Lawrence, Highway Maintenance Man III, 30 years.

District IX

W. Earl Compton, Highway Foreman, 4 years; James W. McGee, Highway Equipment Operator-Laborer, 25 years.

District X

William A. Johnson, Senior Highway Foreman, 28 years; Louis J. Malatesta, Assistant Right of Way Agent, 31 years; Joseph H. Perrin, Highway Foreman, 27 years.

District XI

Kenneth C. Madden, Assistant Highway Engineer, 14 years.

Bridge Department

Lena B. Babcock, Intermediate Clerk, 11 years; Forrest Manhart, Assistant Bridge Engineer, 39 years; Eugene A. Welch, Associate Bridge Engineer, 44 years; Harold J. Whitlock, Senior Electrical Engineer, 35 years; Edward B. Brier, Associate Bridge Engineer, 14 years.

State-owned Toll Bridges

Edgar C. Fraser, Highway Equipment Operator-Laborer, 29 years; George A. Gee, Laborer, 13 years; Thomas B. Narducci, Laborer, 19 years; Mike Pedranti, Highway Equipment Operator-Laborer, 38 years; Roy H. Proffer, Structural Steel Painter Foreman, 24 years; Joseph R. Warne, Highway Chief Clerk I, 30 years.

Materials and Research Department

Roy B. Stratton, Junior Engineering Aid, 27 years; Bailey Tremper, Supervising Materials and Research Engineer, 9 years.

Headquarters Shop

Albert C. Briney, Associate Equipment Engineer, 33 years; Homer T. Forschler, General Superintendent of Highway Shops, 40 years; Dorothy F. Franklin, Bookkeeping Machine Operator II, 25 years; Frank F. Green, Senior Equipment Engineer, 30 years; Ray N. Henderson, Highway Main-

. . . Continued on page 79

Bridge Costs

1961 Average is 6½ Percent Higher Than Previous Year

By H. K. MAUZY, Senior Bridge Engineer, and
W. J. YUSAVAGE, Associate Research Technician

The general trend of bridge construction costs during 1961 has been upward. The construction cost level at the close of 1960 was 249 and, during the following four quarters, rose to successive levels of 259, 261, 269, and 273, or to an overall increase of 9.6 percent. In terms of annual averages, the cost level of 1961, with an average index value of 264, was 6.5 percent higher than the average index value of 248 for 1960.

Although the current rate of increase in bridge construction costs appears unusually large, an analysis of the trend during the years since 1950 and especially, since 1957 shows that the long-term trend has been of the order of a 3 percent annual increase or one which is in line with the general run of the economy. The rather dramatic rise during 1961 is in part a compensatory adjustment for the continuous decline in the level of bridge construction costs from 1957 to the first quarter of 1960. The total decrease in costs during the three year period was 12.4 percent or about 3 percent greater than the increase for the period 1960 to the final quarter of 1961.

The level of costs for successive periods is presented graphically in an accompanying chart which summarizes the course of California bridge construction costs since 1934.

Construction Activity

As a consequence of the Federal Interstate Highway Program, the annual totals for bridge work have increased considerably since 1955. The total value of low bids for the bridge work included in 142 contracts awarded during 1961 was $85,541,483. There were also two contracts, partially financed by a bond issue, for work on the San Pedro-Terminal Island suspension bridge. The total amount for the two contracts was $14,008,140 which together with the $85,541,483 add to a total of contract awards for 1961 of $99,549,523.

The current rate of contract awards in current dollars is more than twice the rate of 1954 and slightly less than twice the rate in terms of 1954 dollars. Bridge construction activity was thus doubled in the period of the past seven years. All future budgets to 1975 anticipate outlays greater than $85,000,000.

Bidder Activity

Bidder activity was significantly curtailed during 1961. The total number of bids submitted for 142 projects was 827 or an average of 5.8 bidders per project. The corresponding figure for 1959 was 8.8 and for 1960, 7.3. The three averages show that the intensity of competition was decidedly falling off during the past three years. Declines in the rate of bidder activity are generally associated with rising bridge costs. Bridge costs followed the pattern during 1961; they were about 6.5 percent higher than during 1960.

Average Unit Prices

The average unit prices of most bridge construction items increased during 1961. The prices of a few of the more significant items have developed trends which are described as follows:

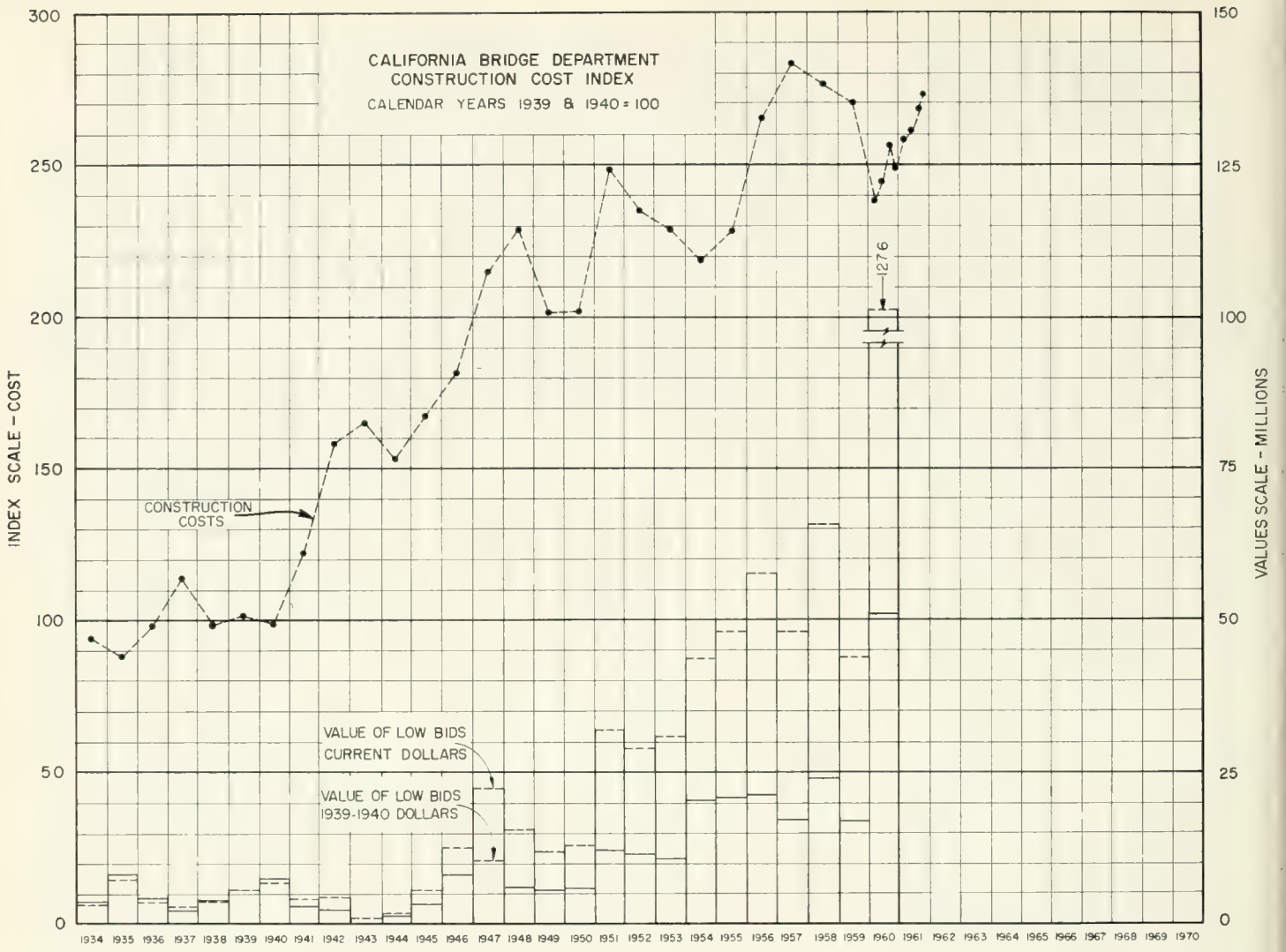
Class A Portland Cement Concrete. The weighted average unit price of the items was in decline for the three years following 1957 when it reached a peak of $58 per cubic yard. The price dropped to $55 per cubic yard in 1958, to $52 in 1959, and to $50.60 in 1960. The trend was sharply reversed in 1961 when the unit price increased to $56 per cubic yard, a 12.6 percent increase over the price of 1960. The geographical pricing pattern for concrete has also changed considerably during the past several years; whereas even a year ago it was common to receive bid prices of between $48 and $52 per cubic yard in the Los Angeles area, bid prices for concrete during 1961 rarely dropped below $54 per cubic yard. On the other hand the prices for concrete in the San Diego area which a few years ago were bid more often in the range of $58 to $60 per cubic yard are currently bid at about $52 per cubic yard. Competition is now more aggressive in the San Diego area than it is in the Los Angeles area.

Bar Reinforcing Steel. The trend of unit prices for bar reinforcing steel has been unusual in that it has been consistently downward since 1958. The weighted average unit prices during 1958 and 1959 were $0.124 and $0.113 per pound. During 1960 the price dropped to $0.097 per pound and, in 1961, dropped still further to $0.094 per pound. Recent bid prices for bar reinforcing steel indicate that the low level prices are still in effect in 1962.

Structural Steel (plate girder). There has been only a moderate change in the unit price of structural steel over the past four years. The corresponding weighted average unit prices for the three years 1958, 1959, and 1960 were $0.164, $0.163, and $0.169 per pound. During 1961 the average unit price increased moderately to $0.173 per pound. The pattern of prices from which the foregoing average prices were computed is apparently continuing into 1962.

Prestressed Concrete. The summary unit price of prestressed concrete is expressed in terms of the price of a composite cubic yard in place. The unit price accordingly includes the cost of the concrete, reinforcing steel, stress steel, anchorages, prestressing operations, as well as the cost of erection.

The corresponding weighted average prices per composite cubic yard of prestressed concrete for the years



1955 to 1960 inclusive have been $135.27, $163.03, $164.48, $144.74, $134.94, and $138.97. During 1961 the weighted average unit price increased to $150.22 per composite cubic yard, or for an increase of 8.1 percent over 1960 prices.

In combination the foregoing items comprise about 76 percent of the total annual cost of bridge construction. For the past two years the low unit prices bid for bar reinforcing steel have, in the aggregate, exerted a strong depressing effect on the overall level of construction costs. Had the prices for bar reinforcing steel followed the general trend of prices of other construction items, the current level of costs would be up another 5 percent.

Summary

An analysis of the general trend of bridge construction costs shows that it parallels the more general trend of the national economy. Accordingly, the bridge cost curve is characterized by high points in the years 1948, 1951, and early 1957, and by low points which coincide with the periods of national recession in 1949, 1954, and 1959. The current rise in bridge construction costs is again accompanied by a resurgence in the vitality of the general economy. The most likely explanation for the correlation of trends is the rise and fall in the rate of competitive bidding; when the national economy is on the rise, there is a concomitant rise in the demand for the services of the construction industry and consequently less interest in bridge construction. The situation is reversed when the general demand for the construction services decreases. Thus there was an average of 8.8 bidders per project during the period of recession in 1959, 7.3 bidders per project during 1960 when the nation was coming out of the recession, and 5.8 during 1961 when the economy was well out of the recession.

In view of the historical relationship of the trend of bridge costs with the trend of the general economy and in view of the current consensus of economic opinion that activity during 1962 will be moderate, it is anticipated that there will be only a moderate increase in competition for bridge projects and, consequently, little change in the current level of bridge construction costs in 1962.

Hawthorne, Belford Retire From State

Two long-time Division of Highways employees have retired in Los Angeles.

Henry Hawthorne, Senior Highway Engineer, closed a 41-year career with the California Division of Highways, most of it spent in District VII, when he retired February 1.


HENRY HAWTHORNE

He was born in Shutesbury, Massachusetts, a descendant of Nathaniel Hawthorne, and studied civil engineering at Carnegie Tech. Before coming West he worked for four years as a transitman and chief of party with survey crews.

He joined the Division of Highways in 1921 and was sent to District I, Eureka.

Early in 1929 Hawthorne transferred to District V, San Luis Obispo, where he worked in surveys for a few months before moving to Los Angeles. He became a Senior Highway Engineer in 1947, and for several years was in Design, working on many of District VII's freeway projects. In 1955 he transferred to the rapidly expanding Right-of-way Engineering Department in an administrative capacity.


H. E. BELFORD

Herbert E. Belford, Senior Highway Engineer, ended 41 years in Southern California highway construction with his retirement on January 31. His career embraced the development of the freeway system in District VII from its beginning with the Arroyo Seco Parkway (now the Pasadena Freeway) to the present 337-mile network.

A native of Williamsport, Pennsylvania, he served in the Army during World War I from 1917 to 1918, then moved to California.

His service with the Division of Highways began February 7, 1921, in Fresno, where he worked for seven years as a civil engineering draftsman and assistant chief draftsman.

In September 1928, he transferred to District VII, Los Angeles. For the first seven years he was supervising designer. In 1935 he was appointed Assistant District City Projects Engineer.

In 1942, he became resident engineer and for most of the years from that time until his retirement he was resident or assistant resident on freeway construction jobs. He worked on the Golden State, Ventura, San Bernardino, Harbor and Hollywood Freeways, and Arroyo Seco Parkway. At the time of his retirement Belford was supervisor of construction projects in the northern part of District VII. It was estimated that he had supervised more than $100 million in construction contracts.

Road Super Garrison Retires in Woodland

Fred R. Garrison, state highway maintenance superintendent for the Woodland territory, retired March 1 after nearly 43 years with the California Division of Highways.

Since 1940 he had been head of the Woodland territory which includes 213 miles of state highways in Yolo, Colusa, and Sutter Counties. Maintenance stations with foremen and a total of 28 maintenance men and drawbridge operators are located at Esparto, Williams, and two at Woodland.


F. R. GARRISON

Born and graduated from high school in Ripon, Garrison started to work for the State in 1919 as a steam shovel engineer.

He was promoted to foreman in 1922 and to highway superintendent in 1930, first heading a traveling crew specializing in mud-jacking operations in various districts throughout the State, and then serving briefly as superintendent of the old Williams territory.

He was superintendent of the foothill-mountain territory, with headquarters in Nevada City, from 1933 to 1940.

In addition to his regular job, Garrison was lieutenant of the Woodland Fire Department for many years.

He and his wife have a son, Fred C., of Los Angeles.

Garrison is past exalted ruler of the Woodland Lodge of Elks as well as past district deputy grand exalted ruler. He has served a total of nine years as president of various chapters of the California State Employees' Association.

Electrical Engineer Whitlock Retires

A long engineering career which has included many major bridges, tunnels and subaqueous tubes came to a close with the retirement of Harold J. Whitlock, Senior Electrical Engineer with the State Division of Highways.

In recent years, Whitlock has been responsible for the design of ventilation and electrical features of such major projects as the Webster Street Tube, connecting Oakland and Alameda, and the Randolph Collier Tunnel in Del Norte County. Additional accomplishments include design of mechanical features of movable bridges such as the Tower Bridge in Sacramento, the Bay Farm Island Bascule Bridge in Alameda, the bridge across Three-mile Slough in Sacramento County and many others.

Early in his career, Whitlock served as an engineering officer and ensign in the United States Navy during World War I, and as an electrical engineer with the Pacific Gas and Electric Company. His first service with the State of California was with the California Civil Service Commission from 1926 to 1930. At that time he began a long career with the Division of Highways which has spanned 31 years.

During World War II, Whitlock served as a commander in the United States Navy and was design superintendent and assistant to the public works officer at the Mare Island Navy Yard.

Whitlock and his wife have two daughters.

Lab's Bailey Tremper Retires January 31

Bailey Tremper, Supervising Materials and Research Engineer, retired on January 31 after 10 years of service with the State of California. Tremper was in charge of the Technical Section, Materials and Research Department Headquarters Laboratories.


BAILEY TREMPER

For 31 years prior to coming to California, Tremper was Materials and Research Engineer for the State of Washington.

Graduating from the University of Washington with a B.S. in chemistry, Tremper was employed in various company laboratories until 1921 when he organized the Laboratory Division for the Washington State Highway Department. While in Washington Tremper carried on original work with asphalts, studied the degradation of aggregates, and developed means of testing traffic paints.

Tremper assumed direction of the Technical Section of the California Materials and Research Laboratory in 1952. He has carried on many research activities in the field of concrete including: reducing the volume change of concrete, concrete mix design, the effects of water reducing additives, durability of concrete in contact with sea water and the effects of freezing and thawing.

He is a member of the American Society for Testing Materials, American Concrete Institute, American Association of State Highway Officials, Highway Research Board, and the Portland Cement Association sponsored Long-Time Study of Cement Performance in Concrete, and others.

Following his retirement Tremper will move to Riverside, California, where he will continue to work on cement and concrete problems with the California Portland Cement Company.

The number of drivers' licenses outstanding in the State at the last completed monthly count was 8,133,198.

Bridge Designer Manhart Retires

Forrest R. Manhart, Assistant Bridge Engineer with the California Division of Highways in Sacramento, retired on January 31 after 40 years as a state engineer.

Most of Manhart's career has been in designing state highway bridges.

Some of the better-known projects on which he has worked include the parallel Carquinez Bridge, the new Colorado Street Arch Bridge in Pasadena, the Benicia-Martinez Bridge, the Whiskey Creek Bridge near Redding, the West Branch of the Feather River Bridge above Oroville and the orthotropic bridge now under construction across Ulatis Creek near Vacaville.

He also prepared design material used in the Hoover-Young Report on the San Francisco-Oakland Bay Bridge, the current San Diego-Coronado Bridge Study and Standards for Elliptic Arch Culverts.

Manhart joined the Division of Highways in 1920.

Manhart is a native Sacramentan and attended local schools. He is a member of the Masonic Lodge.

Manhart and his wife have two daughters: Mrs. Joyce Brady, of Sacramento and Mary Ann, of San Francisco; and three grandchildren.

DIVISION ENGINEERS WIN AWARDS

Two Division of Highways projects have received national awards.

The National Safety Council has announced that "Research Report on Dynamic Full Scale Tests of Highway Median Barriers," submitted by Francis N. Hveem, Materials and Research Engineer, was one of the top three entries submitted to the Metropolitan Life Award for research in accident prevention.

The James F. Lincoln Arc Welding Foundation has announced that its national fifth place award has been given to John J. Kozak and Albert P. Bezzone, of the Bridge Department, for their design of the curved steel girders on the Elysian Viaduct in Los Angeles.

C. R. Burns Retires In San Francisco

C. R. (Bob) Burns, Associate Highway Engineer, retired on February 7, 1962, in San Francisco, after 34 years of state service with the Division of Highways.

He is well known as one of the oldtime location engineers. He has worked on such projects as Castella-Shotgun Creek and Feather River Canyon in District II; Willow Creek, Carmel, San Marcas Pass, and Foxen Canyon, Buellton, in District V; Petaluma Bypass, Santa Rosa Freeways, and Monticello Dam Highway Relocation in District IV.


C. R. BURNS

Burns is a native of the State of Washington. He started his surveying career at the age of 17 with the Idaho and Washington Northern Railway at Spirit Lake, Washington. In 1918, he went to work for the Washington State Highway Department as a Resident Engineer at the Spokane Division. Burns joined the Oregon State Highway Department in 1920, as Locating Engineer. He started to work for the California Division of Highways in 1928 as Resident Engineer in District II.

In 1930 he transferred to District V. Early in 1943 he went to District IV where he was in charge of numerous survey parties until his retirement.

NEW STATE BUILDING

State Director of Public Works Robert B. Bradford has announced that the Division of Architecture has completed plans for the $14.8 million Retirement Building at 9th and O Streets in Sacramento. The general, electrical, mechanical, and elevator portions of the work were advertised for bids Friday, April 20.

The Division estimates this phase of the project will cost about $10,000,000. Bid proposals will be opened in Sacramento on May 22.

ARCHITECT DIVISION LOSES FOUR RETIREES

The following recent retirements have been announced by the Division of Architecture:

Mae Sullivan, for 40 years secretary to the State Architect, retired on January 31.


MAE SULLIVAN

Except for 11 months' service with the Department of Public Health in 1926-27, Miss Sullivan had served continuously with the Division of Architecture since July 1922.

Her first position after graduation from the Sacramento High School in 1917 was as stenographer with the Standard Oil Company.

When she started with the division, there were 48 employees in the office which was then in the Forum Building at 9th and K Streets. With her retirement, only one of those 48 remains in the division.

Miss Sullivan, who has traveled extensively, will depart early in March for the Orient. She will be accompanied by Fay Barrett, retired secretary to the chief counsel, Division of Contracts and Rights-of-way. They plan to continue around the world, moving from place to place without time limitation or particular direction.

Architectural Supervisor Albert Keating retired on January 31.

Keating joined the Division of Architecture in August 1926, and except for short lay-off periods due to lack of work, and a stint with the U.S. Army Engineers during World War II, remained with the division until his retirement. He received his supervisor's rating in 1949.


ALBERT KEATING

After his graduation from Sacramento High School in 1915, he was postmaster at the State Capitol for two years, followed by two years in the Army Air Service. Following his discharge, he did contracting and building work in Sacramento.

Architectural Supervisor Stanley Havlik began his retirement December 1, 1961.

Havlik was born and educated in Chicago, Ill. While attending Armour Institute, he worked for Chicago architects Lonek & Houda and Worthman & Steinbach.


STANLEY HAVLIK

In the early 1920's, he was assistant superintendent of construction of the Pasadena Rose Bowl, and later chief draftsman for Pacific Ready Cut Homes, Los Angeles.

During the early 1930's he was assistant superintendent of construction of the Pasadena Dam, Los Angeles County, and of a large dam in the Canal Zone.

During World War II he was construction expediter for Campbell Construction Co., Sacramento. He rejoined the division after the war and obtained his supervisory rating in December 1956.

Supervising Architect John P. Morgan, who during the few years he was with the Division of Architecture contributed much to state hospital planning and prison design, retired January 1.


JOHN MORGAN

Morgan came to the division in July 1947 from Washington, D.C., where he was hospital architect for the U.S. Public Health Service.

In November 1948 he transferred to the Department of Finance as assistant to the supervising construction analyst. He returned to the division in March 1953, and in October 1954 was appointed supervising architect.

Morgan was born in England, coming to this country in 1912 to study architecture at Carnegie Institute of Technology. World War I interrupted his studies, and for two years he was with the U.S. Army Engineers, American Expeditionary Forces in France.

Following the war he worked in the offices of the late Maj. Henry Hornbostel, Pittsburgh's best known, most colorful and most controversial architect.

In 1923 Morgan returned to Europe for travel and study in England, France, Italy and Spain.

In 1932 he and six others organized a group known as "Sociographics" which engaged in the analysis and graphic presentation of statistics for the Pennsylvania Department of Labor and Industry.

Immediately prior to and during the early years of World War II, Morgan was an architect and group chief of design for the Bureau of Yards and Docks, Navy Department, Washington. He spent the last two war years with the War Production Board.

In recent years Morgan worked closely with the Department of Corrections in developing design studies of new rehabilitation-type prisons, contrasting in concept to older institutions which emphasized, essentially, security.

These original studies became prototypes for the new California Conservation Center, now under construction near Susanville, the three-year-old satellite institution at Soledad, and for the recently completed California Men's Colony at Los Padres.

RETIREMENTS

Continued from page 74 . . .

tenance Man II, 26 years; Ralston W. Hill,* Assistant Highway Mechanic Foreman, 36 years; Philip R. Pallissier, Senior Account Clerk, 16 years.

Shop 2

Harry A. Long, Heavy Equipment Operator, 16 years; Ogle N. Byers, Assistant Equipment Superintendent, 42 years.

Shop 4

Arthur M. Gehl, Assistant Highway Mechanic Foreman, 26 years.

Shop 7

Harold Naylor, Highway Mechanic Foreman, 23 years.

* Disability

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

HIGHWAY TRANSPORTATION AGENCY

ROBERT B. BRADFORD . . . Administrator

DEPARTMENT OF PUBLIC WORKS . . . ROBERT B. BRADFORD, Director

FRANK A. CHAMBERS . . . . Chief Deputy Director

RUSSELL J. COONEY . . Deputy Director (Management)
HARRY D. FREEMAN . . Deputy Director (Planning)
T. F. BAGSHAW . . . . . Assistant Director
JOHN H. STANFORD . . . . . Assistant Director
JUSTIN DuCRAY . Departmental Management Analyst
S. ALAN WHITE . . Departmental Personnel Officer

DIVISION OF HIGHWAYS

J. C. WOMACK . . . State Highway Engineer, Chief of Division

CHAS. E. WAITE . . . Deputy State Highway Engineer
J. P. MURPHY . . . Deputy State Highway Engineer
J. A. LEGARRA . . Deputy State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
GEO. LANGSNER . . Assistant State Highway Engineer
FRANK E. BAXTER . Assistant State Highway Engineer
J. C. BURRILL . . . . . Comptroller
L. L. FUNK . . . . . Planning Engineer
MILTON HARRIS . . . . . Construction Engineer
F. N. HVEEM . . . Materials and Research Engineer
H. B. LA FORGE . Engineer of Federal Secondary Roads
SCOTT H. LATHROP . Personnel and Public Information
H. C. McCARTY . . . . . Office Engineer
A. M. NASH . . . . . Systems Research Engineer
E. J. L. PETERSON . . Program and Budget Engineer
F. M. REYNOLDS . . . . Planning Survey Engineer
EARL E. SORENSON . . . . . Equipment Engineer
E. L. TINNEY . . . . . Maintenance Engineer
W. L. WARREN . . . . . Engineer of Design
G. M. WEBB . . . . . Traffic Engineer
M. H. WEST . Engineer of City and Co-operative Projects
A. L. ELLIOTT . . . . Bridge Engineer—Planning
L. C. HOLLISTER . Bridge Engineer—Special Projects
I. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area

Right-of-Way

RUDOLF HESS . . . . . Chief Right-of-Way Agent
DEXTER D. MacBRIDE . . . . . Assistant Chief
RAY E. O'BIER . . . . . Assistant Chief
R. S. J. PIANEZZI . . . . . Assistant Chief
JACQUES T. ZEEMAN . . . . . Assistant Chief

District IV

J. P. SINCLAIR . . Assistant State Highway Engineer

District VII

E. T. TELFORD . . Assistant State Highway Engineer

District Engineers

SAM HELWER . . . . . District I, Eureka
H. S. MILES . . . . . District II, Redding
ALAN S. HART . . . . . District III, Marysville
L. A. WEYMOUTH . . . . District IV, San Francisco
R. A. HAYLER . . . . . District IV, San Francisco
HAIG AYANIAN . . . . District IV, San Francisco
E. R. FOLEY . . . . . District V, San Luis Obispo
W. L. WELCH . . . . . District VI, Fresno
A. L. HIMELHOCH . . . . District VII, Los Angeles
GEORGE A. HILL . . . . District VII, Los Angeles
A. C. BIRNIE . . . . . District VII, Los Angeles
A. W. HOY . . . . . District VII, Los Angeles
C. V. KANE . . . . . District VIII, San Bernardino
C. A. SHERVINGTON . . . . . District IX, Bishop
JOHN G. MEYER . . . . . District X, Stockton
J. DEKEMA . . . . . District XI, San Diego
CHARLES L. SWEET . . . . . Bridge Engineer
State-owned Toll Bridges

CALIFORNIA HIGHWAY COMMISSION

ROBERT B. BRADFORD . Chairman and Director of Public Works
ARTHUR T. LUDDY . . Vice Chairman Sacramento
JAMES A. GUTHRIE . . San Bernardino
ROGER S. WOOLLEY . . . San Diego
JOHN ERRECA . . . . . Los Banos
ABRAHAM KOFMAN . . . San Jose
FRANKLIN S. PAYNE . . Los Angeles
JACK COOPER, Secretary . . . Sacramento

DIVISION OF CONTRACTS AND RIGHTS-OF-WAY (LEGAL)

ROBERT E. REED . . . . . Chief Counsel

GEORGE C. HADLEY . . . . . Assistant Chief
HOLLOWAY JONES . . . . . Assistant Chief
HARRY S. FENTON . . . . . Assistant Chie

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

NORMAN C. RAAB . . . . Chief of Division
BEN BALALA . . . . . Principal Bridge Engineer

DIVISION OF ARCHITECTURE

EARL W. HAMPTON . . . Acting State Architect, Chief of Division

EARL W. HAMPTON . . . . . Deputy Chief, Architecture and Engineering
HUBERT S. HUNTER . . . . . Deputy Chief, Administrative
ARTHUR F. DUDMAN . . . . . Assistant State Architect (North
TOM MERET . . . . . Assistant State Architect (South
CHARLES M. HERD . . . . . Chief Construction Engineer

DIVISION OF AERONAUTICS

CLYDE P. BARNETT . . . . . Director, Chief of Division

o

55624 3-62 48M

printed in CALIFORNIA STATE PRINTING OFFICE



Lest We Forget



he photograph at the top of the
ge was made in March, 1949, when
earance work was just beginning for
e first contract of the Hollywood
eeway and the now world-famous
ur-level interchange in downtown
s Angeles. The aerial photograph
st above was made when construc-
n had begun, and was retouched to
ow the plan for the finished system.
low is a recent aerial photograph of
is section of Los Angeles, showing
e completed freeway and "The
t"—the depressed section of the
nta Ana Freeway south of the four-
el interchange—which now carries
st about 200,000 vehicles daily.



California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

RETURN POSTAGE GUARANTEED

SEATTLE PUBLIC LIBRARY
4TH & MADISON
SEATTLE 4, WASHINGTON

R56

BULK RATE
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152



Seattle Public Library
JUL 9 1962

TECHNOLOGY
FILE IN STACKS

CALIFORNIA Highways and Public Works



MAY–JUNE
1962

United States of America

Congressional Record

PROCEEDINGS AND DEBATES OF THE 87th CONGRESS, SECOND SESSION

Vol. 108 WASHINGTON, MONDAY, MAY 21, 1962 *No. 80*

Appendix

The California Highway Program

EXTENSION OF REMARKS
OF
HON. GEORGE P. MILLER
OF CALIFORNIA
IN THE HOUSE OF REPRESENTATIVES
Tuesday, May 8, 1962

Mr. GEORGE P. MILLER. Mr. Speaker, from time to time, from various parts of the Nation, criticism is leveled at the Federal highway program, particularly as it relates to the development of the new Interstate and National Defense Systems.

The State of California has an outstanding record as far as highway development is concerned. The State highway commission, established in 1911, has been very progressive in planning ahead to meet the manifold problems of efficiently and effectively moving the large amount of traffic between the various points in our State.

I am particularly pleased to say that the California partnership with the Federal Government, in developing the new Interstate System of Highways, is exemplary for other States to follow in our Nation.

I have just received a letter from the Governor of the State of California which sets forth, in detail, the dynamic spirit of California's highway program and, under leave to extend my remarks, I am pleased to insert this letter to me from the Governor which clearly illustrates the above points:

STATE OF CALIFORNIA,
Sacramento, Calif., May 18, 1962.

HON. GEORGE P. MILLER,
Member of Congress,
House Office Building,
Washington, D.C.

MY DEAR CONGRESSMAN: I understand that concern has been raised in Congress about the handling of the multi-billion-dollar Federal highway program, particularly by the findings of irregularities in some States with respect to the interstate and national defense program for highways.

Without going into statistics or details, I wanted to give you my general comments about the conduct of the highway program in California as I watch it on a day-to-day basis.

First, let me say that the continuation of the present rate of highway construction in California is vital. I think it would be tragic to our economy and to our efforts to remain apace with our population increases if this total highway construction program were seriously curtailed for any reason.

Second, I want to say that I am convinced California's Department of Public Works and Division of Highways cooperate fully, completely, and in honesty with the U.S. Bureau of Public Roads. The regional office of the Bureau of Public Roads for certain Western States is in San Francisco and the State office of the Bureau of Public Roads is right here in Sacramento where there is daily contact between the California highway people and the Federal highway people. Some States, I am told, object to the type of partnership set up between the States and the Federal Government for the interstate program but this is not the case in California, even though California taxpayers send more tax money to Washington for the highway program than they receive back in allocations. Tests and checks applied against the interstate program by the Bureau of Public Roads are cumbersome, costly, and difficult, but we understand that such checks apparently are required and we do not object to them to such a degree that we should like to see any rocking of the boat merely because this working partnership is difficult for both sides to maintain. This Federal-State partnership is carried on in a mutually respectful manner.

Third, the California highway program has been kept free of any irregularities and I am confident this will continue to be the case. We have six different audit groups, Federal and State, looking over the shoulders of the highway people here in California. We have a competent investigating staff here in the State to work with the highway people in pursuing any irregularities which come to light in this big program, and I am confident we have competent and careful direction of the highway program. We take no casual or cavalier attitude toward the huge amount of money which is being spent here in California in the highway program. In addition, I think we have some factors which are not present in some other States. For example, we have a set of laws here in California under the highway program, which I hear are the envy of many other States. We also have a State contract act which I think is the best in the United States. Beyond that, every single individual in our 16,000-man highway division, from the State highway engineer down to the typists, is covered by State civil service law which, at the very least, gives us standards of competence for employment and a rewarding continuity over the years in operations. I know of no allegations of fraud or scandal in the California highway program and, if any such allegations occur, they will be investigated promptly in the hope that we can keep our own house in order without forcing others to do it for us.

Fourth, our State highway commission is composed of dedicated and intelligent men who are appointed for overlapping terms, in order to provide continuity, and they are required by law to take a statewide and not a sectional viewpoint. State law spells out in detail the procedure to be followed by the State highway commission, including the requirement that public hearings be held on a rather heavy schedule. I have insisted, as Governor Knight and Governor Warren insisted, that members of the highway commission be nonpartisan in their conduct of highway policy matters. Our commission is also the envy of other States.

Fifth, we are having the same difficulty some other States are having in locating new routes through built-up areas. This is so because, in a predominantly urban State, there are few perfect corridors still left open through urban areas. Nevertheless, and to my own personal knowledge, these highway routes are being adopted with the public interest and the greatest good for the greatest number in mind. As you know, some persons will be adversely affected by routes through urban areas and it is for this and other reasons that the views of all interested members of the public are sought before freeway routes are established. State law also requires a signed partnership agreement with city councils or county boards of supervisors before any city streets or county roads may be closed in the construction of a freeway.

Sixth, our people in California are trying not only to build an efficient highway system but also a beautiful highway system. We are also cooperating in every way possible to coordinate our program with other forms of transportation.

I attach, for your information, two maps intended to give you a quick status report on work accomplished and work yet to be done (1) on the total State highway system; and (2) on the Interstate Highway System.

This report does not require an answer on your part, but I should always be happy to have any suggestions you might have as to how we may maintain and continue to make improvements in this important program.

I write you because I am fully aware that this program is a joint responsibility between California and the Federal Government. I do not want it hurt or stopped or emasculated because both you and we in the State are looking the other way while others shape its course.

I think you agree that this is a serious piece of business for both of us.

I know you would like me to keep the rest of your colleagues informed on this subject and I will send them the same material.

Sincerely,

EDMUND G. BROWN,
Governor.

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

Vol. 41 May-June 1962 Nos. 5-6



View on front cover is looking upstream along the West Branch of the North Fork of the Feather River with the new West Branch Bridge against the skyline. At present the upper deck which carries relocated Highway U.S. 40 Alternate is 450 feet above the stream, but when the Oroville Dam is completed and the reservoir filled, the water level will be within eight feet of the top of the concrete piers. Old bridge is on county road to Yankee Hill and other foothill mining towns. (See page 2 for story.)

The aerial photograph on the back cover is the Goleta section of U.S. Highway 101, El Camino Real, in Santa Barbara County. Reconstruction and realignment of an eight-mile section of this route as a four-lane divided freeway eliminated the last two-lane section of U.S. 101 in southern Santa Barbara County. The construction in right foreground is work on the future interchange with Ward Memorial Boulevard. (Story on page 34.)



CONTENTS

Page

West Branch Bridge ... 2
By P. C. Harris, Resident Engineer

New Intersection ... 7
By Harter R. Bruch, Senior Civil Engineer, Stanislaus County

Division Issues New Construction Manual ... 9

Bay Area Report ... 10
By J. P. Sinclair, Assistant State Highway Engineer

Route Adoptions ... 32

Goleta Project ... 34
By Roy E. Alderman, District Construction Engineer

Tunnel Lights ... 39
By T. N. Kreiberg, Senior Highway Electrical Engineer

Yolo Causeway ... 44
By R. F. Colley, Resident Engineer, and M. Chapman, District Representative

Meet the Geodimeter ... 50
By George P. Katibah, Supervising Photogrammetrist, and Dan Radmanovich, Geodimeter Party Chief

Span Lift ... 59
By G. C. Smith, Senior Bridge Engineer

Twenty-five-year Awards ... 62

Construction Index ... 62

Letter Cites Highway Foreman's Fast Thinking ... 63

Retirements

John H. Creed ... 31

Mark L. Cardwell ... 33

Arthur W. Root ... 58

T. W. Reynolds ... 60

Recent Retirements Listed ... 61

Obituaries

James E. Martin ... 58

Giles H. Lamb ... 60

Thomas E. Stanton ... 61

In Memoriam ... 62

M. H. West ... 63

LESTER S. KORITZ, *Editor*

STEWART MITCHELL, *Associate Editor* JOHN C. ROBINSON, *Associate Editor*

HELEN HALSTED, *Assistant Editor*

WILLIAM R. CHANEY, *Chief Photographer*

Editors are invited to use information contained herein and to request prints of any black and white photographs.

Address communications to: EDITOR,

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

P. O. Box 1499

SACRAMENTO, CALIFORNIA

West Branch Bridge

Feather River Relocation Ready

By P. C. HARRIS, Resident Engineer



Motorists traveling the famed Feather River Highway, US 40 Alternate, soon will be using the new bridge across the West Branch Feather River. This new bridge, recently completed at a total cost of approximately $1,000,000, is a part of the relocation of a portion of the Feather River Highway and the Western Pacific Railroad around the Oroville Dam and Reservoir and will carry four lanes of traffic on the upper deck and a single railroad track on the lower deck.

The bridge is the connecting link at about the middle of a new highway constructed from Wicks Corner, about six miles north of Oroville, to a junction with the present Feather River Highway about two miles west of Table Cap. Construction of the bridge started in November, 1959, and was completed in February of this year. Work on the approaches has continued through the spring.

The main portion of the bridge spanning the deep canyon of the West Branch Feather River consists of four steel truss spans with lengths of 390 feet, 432 feet, 576 feet and 432 feet, respectively, on massive concrete piers towering up from the bottom and sides of the canyon.

Approach Spans

On the west, or Oroville, end there are five steel girder highway approach spans 80 feet long and one 135 feet long, and on the east end there are one span 135 feet long and three spans 80 feet long. Overall length of the highway portion of the bridge is 2,735 feet; overall length of the railroad portion, including a short approach span at each end, is 1,882 feet. Trusses are spaced 38 feet center to center and are 60 feet deep, except over the two central piers where they are 80 feet deep. Panel lengths are 36 feet.

The highway deck is approximately 450 feet above the stream bed and after Oroville Dam is completed water will be backed up into the canyon to a maximum depth of 350 feet. The two largest piers will extend only about eight feet above maximum high water.

The West Branch Feather Bridge is similar to the Pit River Bridge which carries US 99 across the Pit River arm of Shasta Dam Reservoir. Both carry four lanes of highway traffic on the top deck and railroad on the bottom deck, although the Pit River Bridge carries two railroad tracks instead of one.



Overall view of the West Branch Feather River Bridge looking north toward the Paradise area in Butte County. Department of Water Resources photo.

The Pit River Bridge is longer and has more truss spans, but the layout of spans is similar. Both bridges have unusually high piers. The Pit River Bridge has two piers approximately 355 feet high from foundation base to top of pier which, at the time they were built, were the highest concrete piers in the world. The West Branch Feather River Bridge has two piers approximately 286 feet high from foundation base to top of pier and another one 248 feet high.

Most Massive Pier

Pier 9 on the west side of the stream is the most massive of the three large piers. This pier is located on the end of a spur ridge that branches off from and is roughly parallel to the larger ridge that forms the west side of the canyon.

In order to reach the top of the footing of this pier it was necessary to excavate the end of the spur ridge. On the high side this excavation is on a ½:1 slope for approximately 180 feet.

The footing itself was excavated in hard rock to a depth of 18 feet over an area 82 feet long by 68 feet wide and to an additional 16 feet deep over half of that area. This hole, which was filled with over 5,700 cubic yards of concrete, was big enough to hide an average size 6-room house with a large basement under it and a small yard around it. The footings of all the piers are now covered with backfill material and can not be seen.

On top of the footing is a pedestal 70 feet long, 50 feet wide and 16 feet high. This pedestal has just over 2,000 cubic yards of concrete in it and appears to the observer to be the base of the pier.

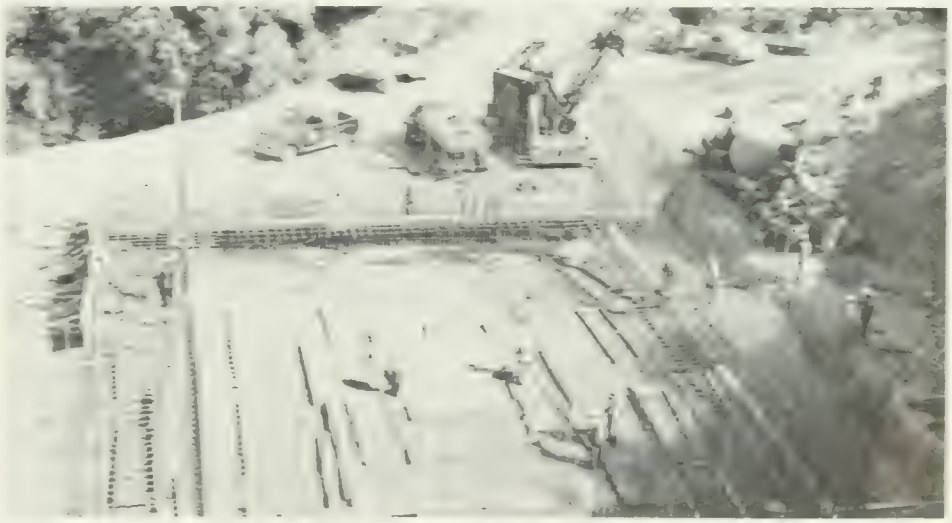
Above the pedestal the shaft of the pier rises in three sections like giant blocks piled one on top of another. The bottom block is 58 feet long, 24 feet wide and 58 feet high; the middle block is 56 feet long, 20 feet wide and 80 feet high; and the top block is 54 feet long, 16 feet wide and 98½ feet high. Four hollow cells, each 11 feet by 12 feet and separated by walls two feet thick, extend from the base of the shaft to within about eight feet of the top. These cells are vented with 12-inch diameter holes to equalize



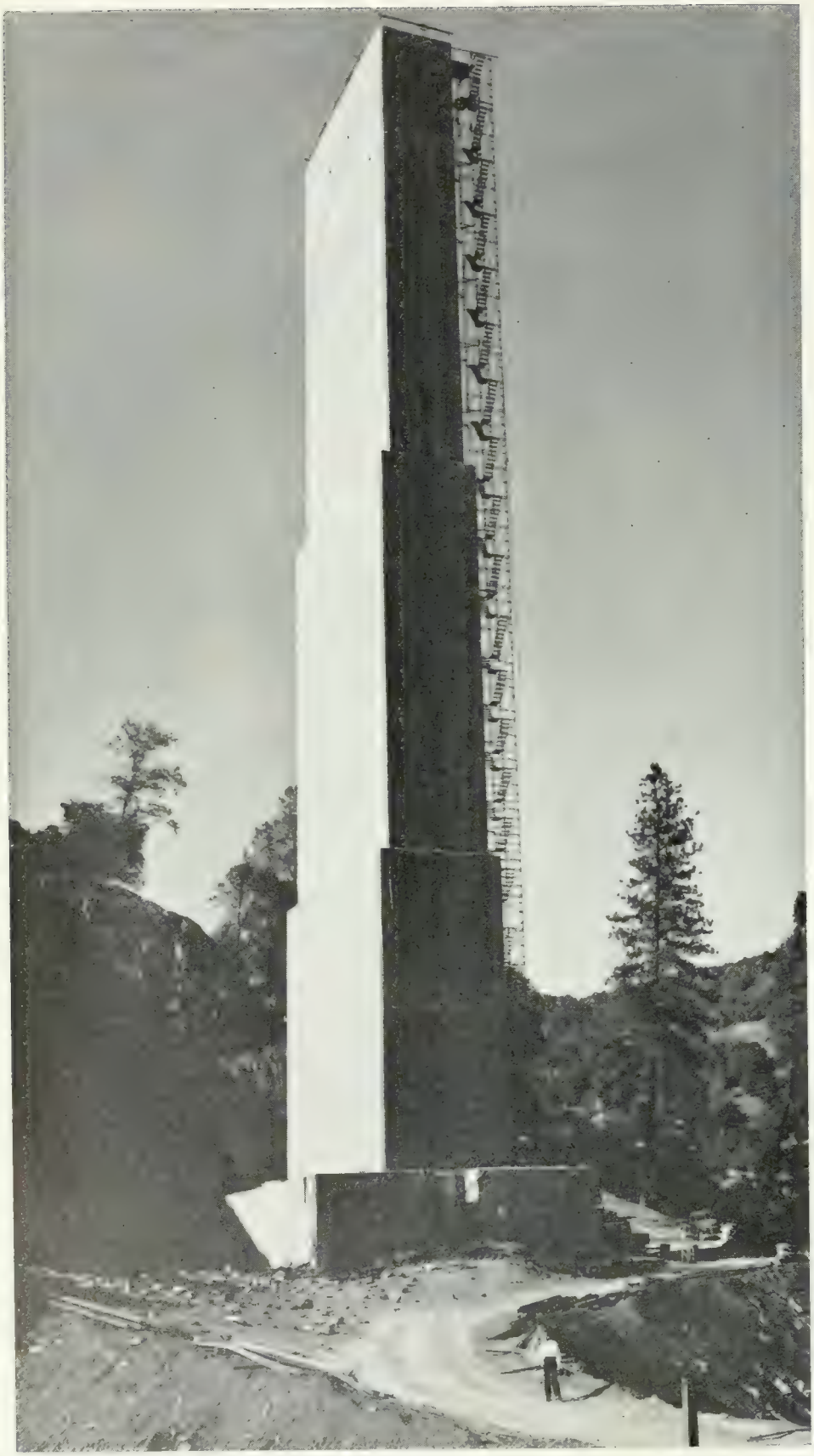
An eastward view of highway deck construction operations. The crane at the far end is filling in secondary structural members.



Placing the connecting steel truss member in Span 9. It was necessary to adjust the opening between the two ends ½ of an inch to fit this member in.



Placing concrete for the Pier 9 footing. The footing contains over 5,700 cubic feet of concrete and is large enough to contain an average size six-room house with a small yard around it.



Pier 9 completed. Total height is 252 feet above ground. The footing extends another 34 feet below ground. The temporary access stairway and railing at the top of the pier were removed after the top of the pier was prepared to receive truss bearings.

water pressures inside and outside the pier and to reduce buoyancy.

The overall height of the pier is equivalent to a 25-story building with a three-story basement and an ordinary railroad box car could be placed on top of the pier with room to spare. Total concrete in the footing, pedestal and shaft is 12,900 cubic yards.

Slipform Method Used

The three large piers were constructed by the slipform method which consists of a form four feet high around the outside of the pier and four interior forms for the inside cells, all attached to hydraulically operated jacks which climb steel rods as the concrete is placed. The jacks climb in increments of approximately one inch and on this job the average rate of rise was just over 12 inches per hour, which meant that the concrete was about four hours old when the bottom of the slipform passed over it.

General procedure was to place the main vertical reinforcing steel for the first section of the pier shaft and then slip that section up to six feet below the change in section; stop and place the main vertical reinforcing steel for the next section; slip the six feet to the change in section and stop and move the forms in to the next section; repeat the procedure for the next sections, with stops at 23 feet and 8 feet below the top of the top section to cap off the interior cells.

For the three piers there were eight major slips ranging in height from 52 feet to 90.3 feet and 11 smaller slips ranging from 6 feet to 15 feet. Average rate of rise for all pours was 12.2 inches per hour. Average rate of rise for the eight major pours was 12.9 inches per hour. Highest rate of rise for any one pour was 14.1 inches per hour for the 90.3 foot top section of Pier 8. Maximum rise for any one hour was about 20 inches. Rate of rise was governed mostly by the speed with which the horizontal reinforcing steel could be placed; only on rare occasions did rate of set of the concrete affect the rate of rise.

Steel Bar "Curtains"

The main reinforcing steel in the three large piers consisted primarily of three vertical curtains of 2⅜"

diameter No. 18 bars. Progressing toward the top, successive bars were dropped off or replaced by smaller bars until, at the top of the piers there were only one or two curtains of 1¼" diameter bars. Prior to the start of placing concrete for each section all main reinforcing steel for that section was placed in position and supported by templates attached to a structural steel tower.

Structural steel towers for supporting the reinforcing steel consisted of six vertical legs placed in 15-foot stories with longitudinal and transverse horizontal and diagonal bracing placed in 7½-foot stories. Outriggers at each end at 30 foot minimum spacing supported the templates for holding the reinforcing steel in place. The vertical legs remained embedded in the concrete, replacing an equivalent amount of reinforcing steel; the horizontal and diagonal braces were removed as the slipform moved up. Towers varied from 60 to 105 feet high; the unsupported length of reinforcing steel above the top of towers varied from 14 to 28 feet. All No. 18 bars were placed full length for each section; maximum length of bar placed was 102′ 9″, weighing approximately 1,400 pounds each.

At the top of the first sections of Piers 9 and 10 where the inside curtain of main reinforcing steel for the bottom section was continuous with the outside curtain of the next section, all the No. 18 bars in this curtain were spliced by butt welding; this required 144 butt welds at Pier 9 and 164 welds at Pier 10. Welding of each joint required from 2 to 3½ hours, with an average of 2½ hours. Welds were radiographed to detect flaws and were repaired when necessary.

All other reinforcing steel, consisting of horizontal bars and ties in the outside walls and interior diaphragms and vertical bars in the interior faces of the outside walls and both faces of the diaphragms, was placed as the slipform moved up. "Chicago" booms, one on each side of the pier, attached to the slipform and operated by winches on the ground, were used to hoist this steel to the working platform and to lower the horizontal and diagonal tower bracing as it was removed.

60 Jacks Per Form

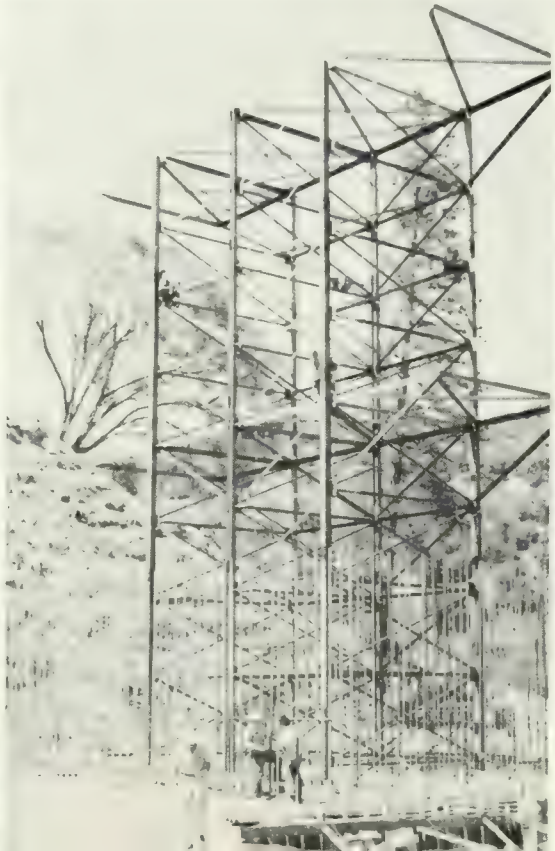
The slipforms were of conventional construction, consisting of four-foot high forms around the outside perimeter and inside the four cells. Sixty jacks were used for each slipform. The jacks climbed one-inch hollow steel rods which were screwed on in increments of about 12 feet as the slipform progressed upward. A small tubular slipform around each rod left a hole around the rod so the rods could be pulled and salvaged; the holes were then filled with grout.

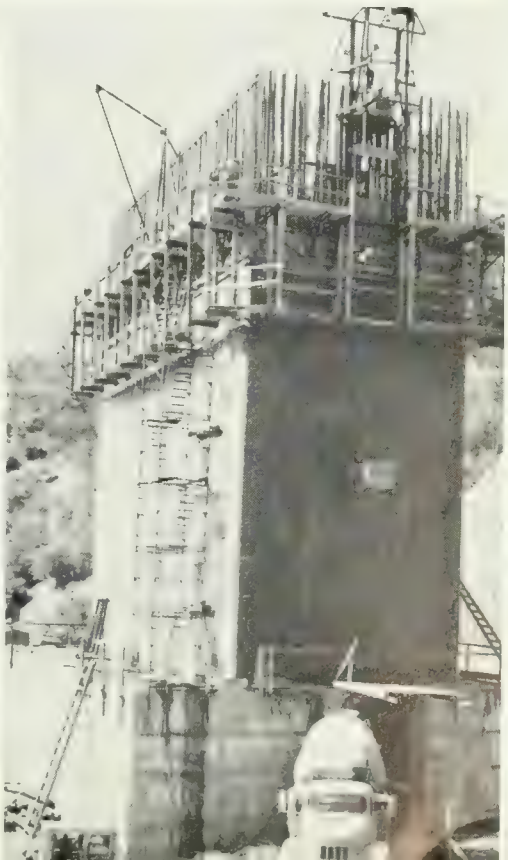
A working platform was constructed over each cell and runways were constructed between the cells over the diaphragms. Another working platform was constructed around the perimeter of the pier outside the reinforcing steel cage. Working platforms for the concrete finishers were constructed under the outside perimeter platform and under the platforms in each cell.

Concrete was delivered to the slipform by means of a skip hoisted on cables to a tower at each end of the slipform. A tripping device dumped the concrete from the skip into a hopper from where it was taken in concrete "buggies" to the pour face around the perimeter of the inside platforms. The skip was operated by a winch on the ground and telephone communication between the winch operator and a man on the skip tower facilitated the operation, particularly

CONSTRUCTION PHOTOS. BELOW LEFT—Steel truss erection being landed on Pier 9. The falsework bent at the middle of Span 8 was built from truss members which later became part of the bridge. Total structural steel in the bridge is 11,000 tons. BELOW CENTER—The main reinforcing steel for the three large piers was supported in place by means of a steel tower. BELOW RIGHT—Slipforming the bottom section of Pier 10. The form itself is four feet high. It moves upward at an average rate of 12 inches an hour propelled by 60 hydraulic jacks climbing on steel rods.









View of the bridge during structural steel erection. The traveller is on the far end. A truck crane over Pier 9 is placing highway deck stringers and secondary truss steel.

at night. The use of a skip suspended from a tower on the slipform was somewhat of an innovation for this type of work. On most other jobs a crane with a long boom or a hoist tower have been used; however, the great height of these piers made either of these methods too costly.

Concrete was cured by means of a series of small spray nozzles suspended about two feet apart below the finishers' platform.

77-Hour Pour

Slipforming is a continuous around-the-clock operation. The longest single pour on these piers required 77 hours.

Structural steel truss erection was started at Pier 7 on the west side of the canyon and proceeded to the middle of Span 9 over the stream, then was started from Pier 11 on the east side of the canyon and proceeded back to a connection in the middle of Span 9. Erection was by the "cantilever" method with a large traveller crane moving along with the end of steel as work progressed. A crawler crane near the end of the bridge loaded steel members onto small rail cars and a small Diesel locomotive pushed the cars over a supply track, installed over one of the truss chords, out to the traveller.

Five falsework bents were used, two each in Spans 7 and 10 and one at the middle of Span 8. The falsework bents under Panel Point 2 in Span 7 and Panel Point 38 in Span 10 were made up of steel members brought to the jobsite for that purpose by the contractor; the other three bents were made up from truss members which were later used in the bridge. At Piers 7 and 11 the ends of the trusses were tied down by means of temporary steel members embedded in the pier concrete to resist the uplift caused by the cantilever erection. At Pier 8 temporary pinned connections were installed between the top chords of Spans 7 and 8 and temporary bearing plates were placed between the bottom chords to make the trusses act continuously over the pier during erection of Span 8. Wire rope tie-downs were installed between the top chords of Span 8 and the bottom chords of Span 7 to resist uplift while cantilevering Span 8 from the falsework bent to Pier 9. Jacks were installed in the top chords at the fixed (west) end of the suspended span in Span 9 and in both top and bottom chords at the expansion end to assist in making the closure at the center of the span. Closure of the downstream chord was perfect; closure of the upstream chord was long by $\frac{3}{8}$", but was easily adjusted.

Heaviest Member

Total structural steel in the bridge is 11,000 tons. Members were shop-fabricated using rivets; field connections were made with high strength steel bolts. Many of the individual members weighed in excess of 30 tons each; the heaviest single member weighed 56 tons, the equivalent of about 30 ordinary automobiles.

All of the railroad ballast deck and the highway deck in Span 7 were constructed of lightweight concrete weighing about 105 pounds per cubic foot, compared with about 155 pounds per cubic foot for conventional concrete. Total concrete used in the bridge was over 40,000 cubic yards and nearly 4,000 tons of reinforcing steel was required.

The bridge was designed and the construction was administered by the Division of Highways under a service agreement with the State Department of Water Resources. Financing was with Feather River Project funds provided by the Department of Water Resources with some state highway funds being used to the extent of the "betterment," such as the four-lane width. Design and construction were under the general administration of J. E. McMahon, Assistant State Highway Engineer—Bridges. Design was done by a crew headed by R. D. Sunbury and J. R. Stoker. P. C. Harris was resident engineer and D. P. Hopkins was assistant resident engineer during construction. General contractor for the construction was Stolte, Inc. and Morrison-Knudsen Co., Inc., with George Trivitt as project manager and C. W. Young as field engineer. Subcontractor for structural steel was American Bridge Division of United States Steel Corporation. Subcontractor for reinforcing steel was Soulé Steel Co.

At the time of writing this article a contract was under way for paving about a half mile of approaches to the bridge and making the connection to the existing highway near Jarbo Gap. This work is scheduled for completion early this summer, after which highway traffic can be routed over the new highway and bridge. At the same time the relocation of the Western Pacific Railroad line is nearing completion and the first trains should pass over the new bridge in late summer or early fall.

New Intersection

Stanislaus County Constructs F.A.S. Project Near Modesto

By HARTER R. BRUCH, Senior Civil Engineer, Stanislaus County



STANISLAUS County and the State Division of Highways, by means of a co-operative project, have completed construction of a channelized intersection which is a fine example of the spirit of co-operation existing between the two agencies.

The project is at the intersection of Yosemite Boulevard (State Sign Route 132) and El Vista-Snowden Avenue, at the eastern edge of the City of Modesto.

The term "channelized intersection" is somewhat misleading insofar as the size of the project is concerned. The work accomplished involved the reconstruction and widening, from two to four lanes, of almost one-half mile of state highway and one-fourth mile of county road, plus reconstruction only of another one-half mile of county road.

Result of Three Projects

The need for this improvement developed as a direct result of three projects constructed earlier on F.A.S. Route 1226 and described in the September-October 1958 issue of California Highways and Public Works. At the time these projects were programmed, it was estimated that the traffic count, upon completion of the route (known as East Modesto Road), would be approximately 2,000 vehicles per day. Within one year, however, the traffic count was over 5,000 vehicles per day. With traffic on the state highway approaching 7,000 vehicles per day, the congestion at the intersection became critical. The situation was made even worse because of the following existing conditions: (1) the high percentage of turning movements; (2) the north and south legs of East Modesto Road being offset by 40 feet, and (3) the tracks of the Modesto and Empire Traction Company (paralleling Yosemite Boulevard) being two feet above the road.

The project borders one of the industrial areas of the City of Modesto. This particular area contains many food processing plants and related industries, which create a high percentage of truck-type traffic during certain periods of the year. In addition, the Modesto City-County Airport is located one-half mile south of the intersection.

County Handles Construction

After preliminary discussions with Division of Highways personnel, it was decided that the proper approach to the solution of the problem would be to propose a county-constructed project rather than the usual procedure of requesting the State to construct the project, with the county participating only financially. The division's traffic engineers studies the situation and recommended a fully channelized and signalized intersection with left-turn lanes on all four legs. The design was approved in October 1959.

Thereafter, an agreement was negotiated providing for the following: (1) the county to design and supervise the construction of the project with county personnel, acquire all necessary rights-of-way, and pay one-half of the construction cost, and (2) the State to provide plans and speci-



BEFORE—The intersection before it was reconstructed. The view is north along Vista Avenue. *(See photo next page.)*

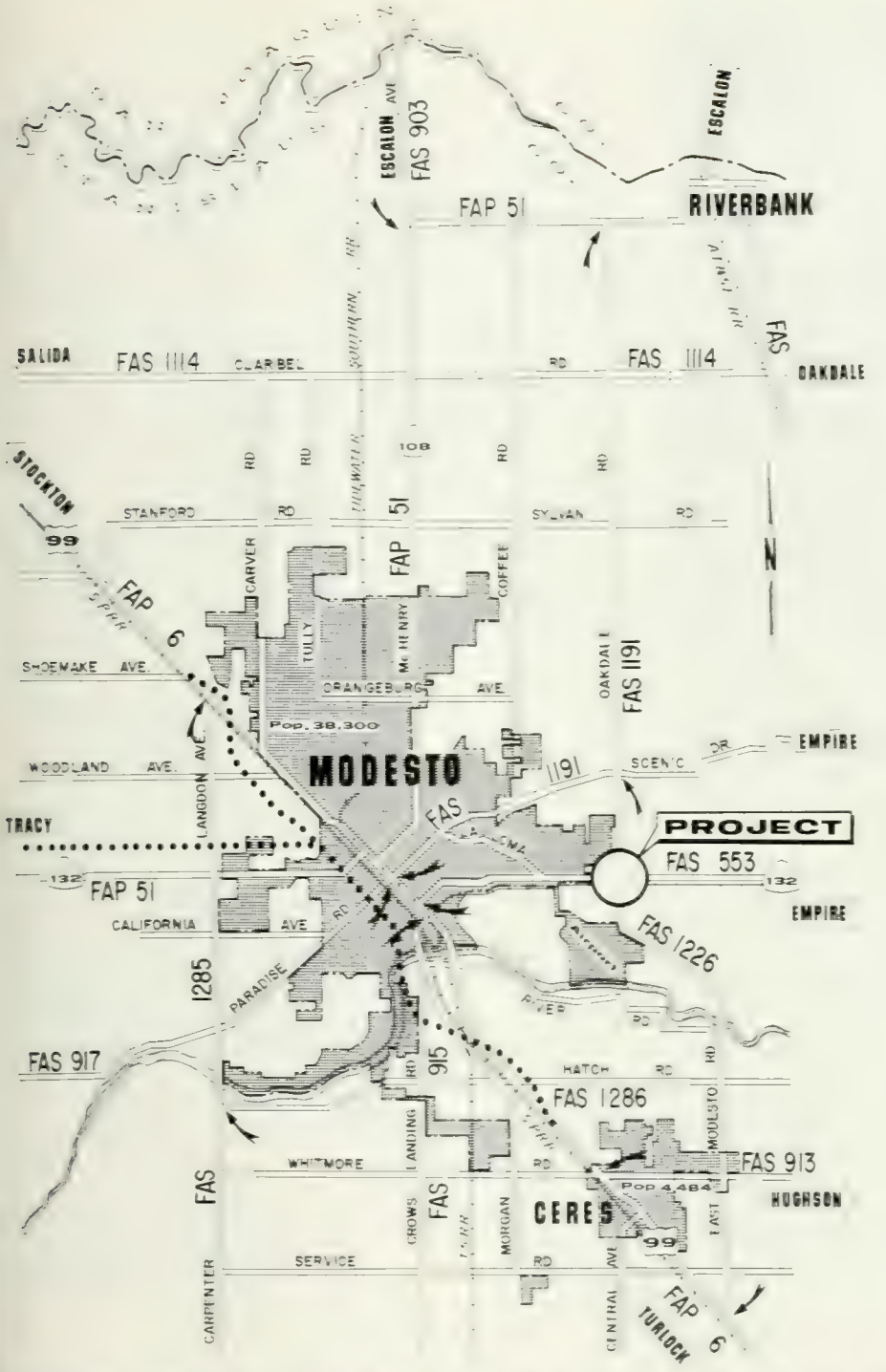


AFTER—The completed project looking west along Yosemite Boulevard (State Sign Route 132) toward the City of Modesto. (See photo previous page.)

fications for the electrical work and pay one-half of the construction cost. Under a separate agreement, the county and the Modesto and Empire Traction Company installed No. 8 flashing light railroad signals on the south leg of the intersection. The railroad signals were interconnected with the traffic signals to provide preemption for the railroad.

Rights-of-Way Acquired

The county acquired all of the rights-of-way necessary for the project, including those required on the state highway. The City of Modesto assisted in the right-of-way acquisition, since the property in the northwest corner of the intersection is within the Modesto city limits. As a result of excellent co-operation by the



The project is located near the southeast city limits of Modesto as indicated in the above map and connects two Federal Aid Secondary County Routes.

City of Modesto, most of the necessary rights-of-way within the city were acquired by dedication.

Bids for the project were opened on February 28, 1961. The contract was awarded to Standard Materials of Modesto for $141,414.10.

Although it was necessary to carry traffic through the project during construction, it was completed with a minimum of inconvenience. The project was completed on July 18, 1961. It is the first signalized intersection in District X with traffic-actuated left-turn signals on all four legs. The final construction cost was $144,657.91. Of this total, the State's share was $54,652.85 and the county's share was $90,005.06.

This project had the fullest co-operation of District X, particularly, City and County Projects Engineer, Al Tschantz-Hahn and his staff. Don Hubbard of Stanislaus County was Resident Engineer; the author supervised both design and construction. The entire project was under the direction of Ellis R. Delbon, Road Commissioner.

Division Issues New Construction Manual

A revised and enlarged edition of its "Construction Manual of Instructions" has been issued by the State Division of Highways.

The publication, as in its previous editions, is a continuing attempt to compile in writing the field "know-how" accumulated by experienced resident and construction engineers of the division.

It suggests techniques helpful in completing a construction project in accordance with controlling plans, specifications and other contract documents which will assure proper quality and quantity control.

Under nine main headings, the manual deals with some 70 topics ranging from construction details and the sampling and testing of materials to personnel and public relations problems that may arise in connection with a job.

The manual contains many charts, tables and photos illustrating the points discussed. Copies of the 590-page, paper-covered book, which is in an 8½-by-11-inch format, may be purchased from the Documents Section of the State Printing Division, Sacramento 14, California. The price is $9, plus sales tax of 36 cents for California purchasers.

The Division of Architecture has completed plans on the general, mechanical, electrical, and elevator work for the $14,800,000 Retirement Building in Sacramento. This project will be the first new building under the California State Capitol Plan to become a reality. This plan was approved by the 1961 Legislature.



Construction progresses on the new Caldecott Tunnel Portal at the west end of the existing tunnel. Funds have been budgeted to replace the present four-lane undivided approaches on Sign Route 24 with an eight-lane freeway.

Bay Area Report

By J. P. SINCLAIR
Assistant State Highway Engineer



A CENTURY AGO, waterways were the key to the growth of California. Hundreds of ships coming around the Horn brought people, tools and material to develop the newly discovered goldfields. On the Sacramento and the San Joaquin Rivers, thousands traveled by boat to seek their fortunes in the headwaters of the Sierras.

Today the great waterways handle only a small portion of the total traffic. The railroads, which moved so many people and goods from place to place in the early part of this century, have also assumed a lesser role. Replacing these time-honored modes of travel, the boat and the rail, are miles and miles of concrete and asphalt highways and freeways two, four and eight lanes wide. The Golden Gate, the Carquinez Straits and the San Francisco Bay, have been spanned by mighty bridges to accommodate the ever-expanding tide of automobiles.

The task of the District IV highway engineers in the Bay area, is not only to provide a means of safe and rapid travel for this growing tide of motorists with their cars and trucks, but to insure the same pleasant prospect for the additional thousands who will be driving on Bay area highways in future years.

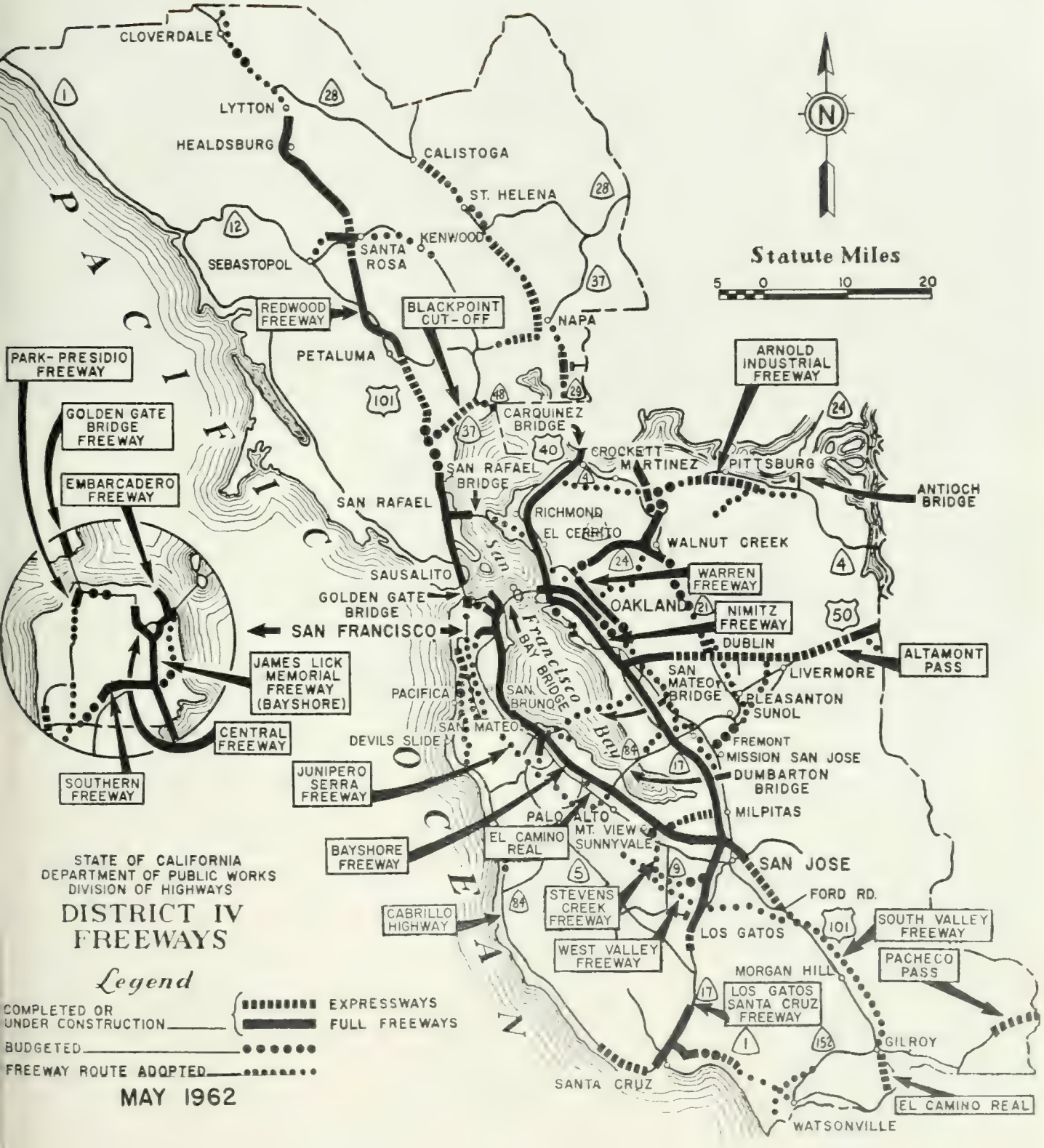
Commuters Increase

Unlike gold rush days, when much of the incoming population left the Bay area seldom to return, many now make a two-way trip daily. They earn their livelihoods in the metropolitan communities of the Bay area, such as San Francisco, Oakland, Richmond, San Jose and Santa Rosa, and often choose suburbs on either side of the Bay or several counties away to join their families in residence or spend their leisure time.

From San Francisco, and Oakland, freeways now provide effortless travel north to Santa Rosa and Sacramento and south to San Jose. More than ever before, the continuity of route development is in evidence.

Completion of the Bayshore Freeway from San Francisco to San Jose, the recent completion of three contracts on the MacArthur Freeway, the Southern Freeway now under contract throughout most of its length, the rapid closing of the gaps on the US 101 Freeway through Marin and Sonoma Counties, all are examples of major route development. One can now drive from Watsonville to the Carquinez Bridge, the entire length of District IV, and not stop for a single traffic signal.

This has not always been accomplished without controversy. That so much has been achieved with little or no controversy is testimony to the willingness of those who build for the future to consider the views of those who would preserve the past. When viewed against the backdrop of Bay area history, beauty, commerce and trade, the achievements listed below become an important part of the growth of not only the Bay area but of California itself.


CLOVERDALE
LYTTON
HEALDSBURG
CALISTOGA
ST. HELENA
SEBASTOPOL
SANTA ROSA
KENWOOD
NAPA
PETALUMA
REDWOOD FREEWAY
BLACKPOINT CUT-OFF
PARK-PRESIDIO FREEWAY
GOLDEN GATE BRIDGE FREEWAY
EMBARCADERO FREEWAY
SAN RAFAEL
SAN RAFAEL BRIDGE
CARQUINEZ BRIDGE
CROCKETT
MARTINEZ
PITTSBURG
ARNOLD INDUSTRIAL FREEWAY
ANTIOCH BRIDGE
RICHMOND
EL CERRITO
WALNUT CREEK
SAUSALITO
GOLDEN GATE BRIDGE
SAN FRANCISCO
WARREN FREEWAY
OAKLAND
NIMITZ FREEWAY
DUBLIN
ALTAMONT PASS
LIVERMORE
PLEASANTON
SUNOL
SAN MATEO BRIDGE
JAMES LICK MEMORIAL FREEWAY (BAYSHORE)
PACIFICA
SAN BRUNO
SAN FRANCISCO BAY BRIDGE
CENTRAL FREEWAY
DEVILS SLIDE
SAN MATEO
FREMONT
MISSION SAN JOSE
DUMBARTON BRIDGE
SOUTHERN FREEWAY
JUNIPERO SERRA FREEWAY
MILPITAS
PALO ALTO
MT. VIEW
SUNNYVALE
EL CAMINO REAL
BAYSHORE FREEWAY
SAN JOSE
FORD RD.
STEVENS CREEK FREEWAY
CABRILLO HIGHWAY
LOS GATOS
SOUTH VALLEY FREEWAY
PACHECO PASS
WEST VALLEY FREEWAY
MORGAN HILL
LOS GATOS SANTA CRUZ FREEWAY
GILROY
SANTA CRUZ
EL CAMINO REAL
WATSONVILLE
PACIFIC OCEAN
San Pablo Bay
Statute Miles
5 0 10 20
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
DISTRICT IV
FREEWAYS
Legend
COMPLETED OR UNDER CONSTRUCTION
EXPRESSWAYS
FULL FREEWAYS
BUDGETED
FREEWAY ROUTE ADOPTED
MAY 1962



Freeway landscaping. The Ashby Avenue Interchange on US 40 in Berkeley, looking northeast. Field of flowers in the foreground and beyond is iceplant. Shrub clumps add variety and accentuate the structure.

ALAMEDA COUNTY

The variety of completed, current and budgeted projects within Alameda County ranges from minor projects such as traffic signal modification and widening to major contracts including new freeway alignment, tunnel and tube construction. Some of the most significant developments during the past year were the opening to traffic of three units of MacArthur Freeway (US 50 and Interstate 5W) in May, continued improvement of the Nimitz and Warren Freeways and of State Sign Route 24 between Oakland and the Contra Costa suburban areas.

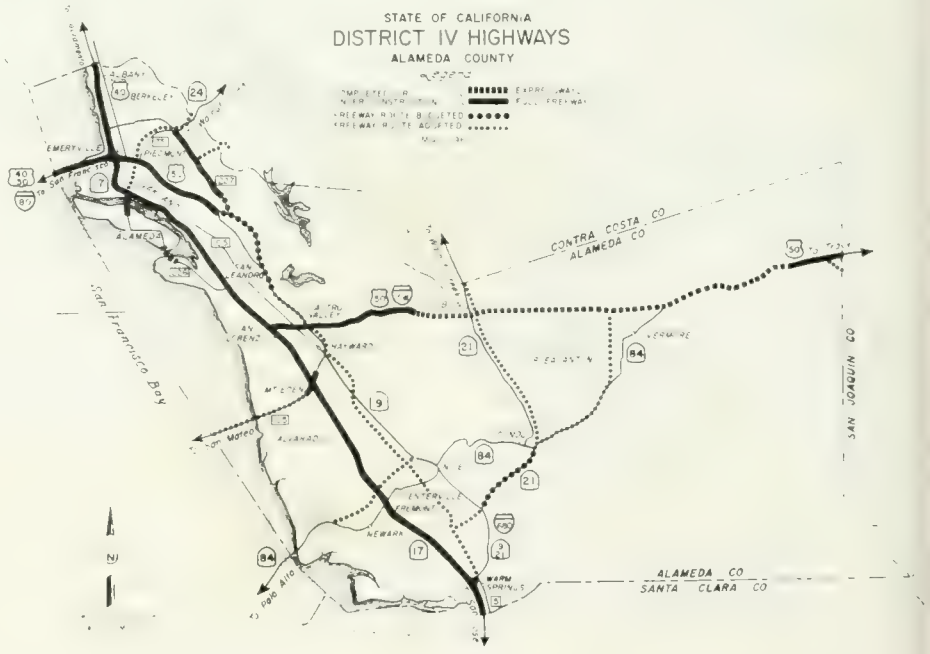
In addition to the above work, funds are budgeted for freeway construction on Interstate 680 (State Sign Route 21) between US 50 and Scotts Corner and for rehabilitation of the existing Posey Tube upon completion of the Webster Street Tube. Numerous other projects were completed or are currently underway on Sign Routes 9 and 84 and State Highway Route 105, in Hayward.

MacArthur Freeway (Interstate 5W)

The opening of the first section of MacArthur Freeway on May 15 provides 2.6 miles of continuous eight-lane interstate freeway between the distribution structure and Grand Avenue in Oakland.

The three contracts within this area cost approximately $11,596,000 and included construction of 18 undercrossings and overcrossings for the freeway and ramps and the construction of the substructures for the future MacArthur-Grove Shafter Freeway Separation. Modified diamond interchanges with additional ramps and connections where required by traffic demand were constructed at existing MacArthur Boulevard, Oakland Avenue-Harrison Street interchange and at Grand Avenue. These contracts were constructed by C. K. Moseman and Son, Guy F. Atkinson, and Peter Kiewit Sons Co., respectively.

Bids were opened in June for a $47,000 contract for resurfacing existing US 50 along MacArthur Boulevard between the west city limits of



Emeryville and Broadway prior to relinquishment to the City of Oakland.

Units Under Construction

East of Grand Avenue, two units of MacArthur Freeway are currently under way between Grand Avenue and Buell Street. When complete, these contracts together with those just opened to traffic will afford 6.5 miles of eight-lane freeway between the distribution structure and Mills College.

Four traffic separation structures, two pedestrian overcrossings and 11 retaining walls are being built by Peter Kiewit Sons Co. on the 1.7-mile contract between Grand Avenue and 14th Avenue. A modified split diamond interchange with additional ramps and channelization is being constructed in the Grand Avenue-Lakeshore area; at Park Boulevard, a modified half diamond with additional ramps is being constructed. This contract will cost approximately $4,392,000.

The 2.9-mile contract between Park Boulevard and Buell Street will cost approximately $7,680,000 and is being performed as a joint venture by Stolte Inc. and Morrison-Knudsen Co. Inc. Seven modified diamond interchanges are being constructed and a total of 15 structures are under construction to carry traffic over or under the freeway. A pedestrian separation is being built in the vicinity of Redding Street and 19 retaining walls are required to minimize right-of-way requirements.

Additional MacArthur Projects

Two additional projects are budgeted on MacArthur Freeway. $12,000,000 has been allotted for 4.5 miles of freeway between Buell Street and the east city limits near Durant Avenue. This project includes the connection to Warren Freeway in the vicinity of Calaveras Avenue, where a full directional interchange will be constructed. Modified diamond interchanges will be constructed at five other locations and a total of 12 overcrossings and undercrossings will be built.

South of the above project, $4,500,000 is budgeted for 1.9 miles of freeway between the city limits of Oakland and Sybil Avenue in San Leandro. The major interchange on this unit will be the directional type to be built at the intersection with existing Foothill Boulevard at the northerly end of the project. Seven undercrossings will be built for city streets and ramps in addition to two bridges to be constructed over San Leandro Creek for the freeway and a frontage road.



The MacArthur Freeway in downtown Oakland (Interstate 5W). The portion between the Distribution Structure and Grand Avenue was recently opened to traffic.

Funds are also budgeted for two landscaping projects on completed sections of MacArthur Freeway: $170,000 for the 2.3-mile section between the distribution structure and Grand Avenue and $195,000 for the unit between Grand Avenue and Park Boulevard when complete. (A progress report on the MacArthur Freeway will be published in the July-August 1962 issue of *California Highways and Public Works.*)

US 40 Construction

On US 40 (Interstate 80), $654,800 financed from toll bridge authority bonds was expended to reconstruct the San Francisco-Oakland Bay Bridge eastbound toll plaza and approach roadways. Three collection booths were added and the existing booths were revised to provide for collection from the driver's side. This work, completed in January, will accommodate the planned switch to one-directional traffic on each bridge deck upon completion of the current bridge modifications. Bids were opened May 31 for further revisions on the approaches in order to complete this modification. $119,500 has been budgeted for this work.

Currently under construction is five miles of median barrier, consisting of both cable chain link and

blocked-out metal beam guard rail, between El Cerrito Overhead and San Pablo Dam Road. This contract is for $89,000.

Nimitz Freeway

Planned improvements on Nimitz Freeway (State Sign Route 17) continue. In March of last year $276,000 was expended to construct a 164-foot overcrossing at Floresta Boulevard in the City of San Leandro. The city contributed $137,500 to the cost of the contract which included grading and surfacing approach roadways.

Currently in progress is the 5.6 mile widening contract between Fallon Street and Hegenberger Road in Oakland which, when complete, will provide 8 lanes on Nimitz Freeway between El Cerrito Overhead and Hegenberger Road. This $4,441,000 contract, being performed by Dan Caputo and Co. and Cambrian Gateway, includes erection of blocked out metal beam guard rail. The work includes widening the High Street, Fruitvale and 5th Avenue Overheads and modification of inlet and outlet ramps at Hegenberger Road, High Street, 29th Avenue and 23rd Avenue interchanges. The existing left hand off-ramp at 42nd Avenue will be replaced with a right side takeoff.

South of Oakland, funds are budgeted for two additional construction projects on the Nimitz Freeway. Two diagonal ramps will be constructed at First Avenue Interchange and the existing two-lane overcrossing will be widened to four lanes. $482,000 has been allotted for this project. $85,000 has been budgeted for 4.3 miles of cable chain link barrier between Jackson Street in Hayward and Washington Avenue in San Leandro.

A landscaping project was completed between 5th Avenue Overhead and Linden Street in Oakland in March of last year. Presently underway is a 2.3 mile, $87,200 contract for landscaping and installing an irrigation system on the portion of Sign Route 17 between Central and Thornton Avenues, in Fremont.

Warren Freeway (Route 227)

Landscaping was also recently completed on the portion of Warren Freeway between Broadway Terrace and Redwood Road. $48,000 was expended to plant trees and shrubs.

Other improvements on Warren Freeway include the southerly portion included in the budgeted project on MacArthur Freeway and the current contract being built by Dan Caputo Co. for the construction of the Moraga Avenue Interchange at a cost of $1,292,000. This modified diamond, with additional connections and the construction of the Moraga Avenue Undercrossing will replace the existing signalized intersection.

State Sign Route 24

On State Sign Route 24, the current contract for the additional bore at Caldecott Tunnel is underway (see Contra Costa County). Funds are also budgeted for 1.5 miles of 8-lane freeway between Warren Freeway (State Highway Route 227) and the tunnel. Only that portion of the interchange at the westerly end of the tunnel and those frontage roads required to provide access to the tunnel for maintenance forces will be constructed on this $2,715,000 project. The remainder of this interchange and frontage roads, an avercrossing and the Warren Freeway-Highway 24 interchange will be built later.

An interim project at the intersection of Patton Street and Broadway in Oakland was completed on State Sign Route 24 for traffic signals, lighting and channelization at a cost of $49,000.

Webster Street Tube

Between Oakland and Alameda, work is still in progress on the $17,363,000 contract for the Webster Street Tube. The last of the prefabricated sections has been set in place and work is in progress to seal the last two sections. The 3,350 foot long tube is the twelfth underwater tube completed by this method, the adjacent Posey Tube having been the first.

The new tube will provide a two-lane roadway and, upon rehabilitation of the Posey Tube, one-way directional traffic will be accommodated in each tube. The contractor on this work is Pomeroy-Bates and Rogers & Gerwick.

As a part of the Webster Street Tube construction, $450,000 was expended on a contract completed in August to grade and surface a storage area between Mallory Street and Mitchell Avenue in Alameda. Drainage facilities and electrical systems were also installed. The work completed under this contract replaces U.S. Army facilities which were required for construction of the tube.

$1,100,000 has been budgeted for revisions of the existing Posey Tube which will be started as soon as traffic can be diverted to the completed Webster Street Tube. The proposed work includes tunnel entrance revisions, lighting, modification of the ventilation equipment and facing the interior with ceramic tile.

Sign Route 21 (Interstate 680)

Six and one-tenth miles of initial four-lane, ultimate six-lane, freeway is budgeted on State Sign Route 21 between State Sign Route 9 near Mission San Jose and Scotts Corner. This facility is part of the Interstate System (Route 680).

Interchanges and traffic separation structures will be constructed at Mission Boulevard and Vargas, Sheridan, Andrade and Calaveras Roads on this $6,200,000 project. Major structures will also be built over Alameda Creek. North of this project 1.8 miles of resurfacing of existing Sign Route 21 was completed between US 50 and the Alameda-Contra Costa County line at a cost of $62,500.

State Route 105 (Jackson Street)

Currently in progress is a 1.7 mile contract, costing $2,143,000, between Harder Road and Castro Street (Mission Boulevard) in Hayward. This work is being done by Gallagher & Burke. Route 105 (Jackson Street) is being widened to a four-lane divided arterial with parking lanes. The substandard underpass under the Western Pacific Railroad is being replaced. An underpass is also being constructed at Orchard Avenue under the Southern Pacific Railroad. The City of Hayward contributed $74,400 and the Southern Pacific Railroad $73,400 to assist in the financing.

Other Projects

Many other projects were completed on State Sign Routes 9 and 84 in Alameda County during the past

year. These included the $761,000 contract for widening 4.0 miles of Mission Boulevard (Sign Route 9) between Sycamore Avenue and Gresel Street in Hayward. An 80-foot roadbed with a 16-foot concrete median island was constructed and highway lighting and traffic signals were installed. The City of Hayward will plant trees in the median strip of this project.

On Sign Route 84, shoulders were reconstructed and some realignment and resurfacing was done on the 6.2-mile portion between Mission Boulevard in Fremont and Sunol at a cost of $79,200. Peralta Boulevard between Fremont Boulevard and State Sign Route 9 was also widened and resurfaced. This 2.5-mile contract was completed in July at a cost of $85,900.

CONTRA COSTA COUNTY

With the completion of US 40 (Interstate 80) to full freeway between the Bay and Carquinez Bridges, construction emphasis has shifted eastward to development of State Sign Route 21 (Interstate 680) north and south of Walnut Creek, and to completion of Sign Route 24 between the metropolitan communities and the rapidly expanding suburban areas east of the Berkeley hills. Several projects on these routes, currently under way or budgeted, when complete will provide approximately 30 miles of continuous freeway from Caldecott Tunnel in Oakland to US 40 north of Vallejo via the Benicia-Martinez Bridge.

Sign Route 21 (Interstate 680)

Bids were opened May 16, 1962, for a 6.8-mile contract on Sign Route 21 between 1.0 mile south of Danville and Walnut Creek. This initial four-lane, ultimate six-lane freeway will connect to the existing Sign Routes 21 and 24 Bypass in the vicinity of Walnut Creek and will cost approximately $12,900,000, representing the largest single contract budgeted in the San Francisco Bay area.

Major Structures

A total of 13 major structures are to be completed, including four separate bridges over San Ramon Creek and an overhead over the Southern Pacific Railroad north of Sycamore Valley Road. Interchanges will be provided at Sycamore Valley, Diablo, El Fintado, El Alamo, Stone Valley, Livorna and Rudgear Roads. Contra Costa County will contribute approximately $343,000 toward the cost of county road construction and local drainage improvements.

Monument Road Area

In the area north of Walnut Creek, a portion of Sign Route 21 between Monument Road and Willow Pass Road is included in the project budgeted on Sign Route 24 between 0.2 miles south of Monument Boulevard to 0.1 mile south of Olivera Road. Bids were opened on May 23 for this 3.8-mile project which will cost approximately $5,450,000. A diamond interchange will be constructed at Monument Boulevard and cloverleaf interchanges will be built at Grant Street and Willow Pass Road. Five undercrossings as well as structures over Walnut and Pine Creeks and an overhead over the Southern Pacific Railroad at Concord Avenue will be constructed.

Four Interchanges

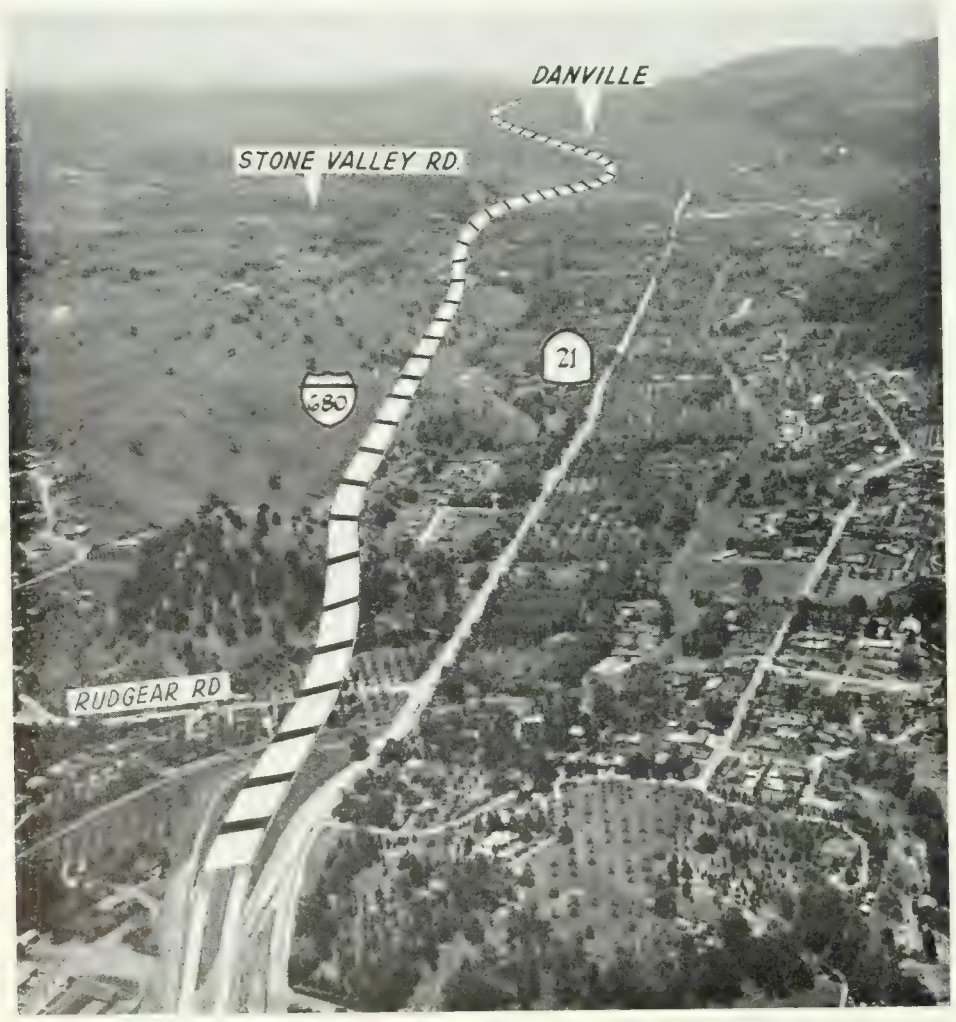
North of the above project, work is under way on a 4.2-mile portion of Sign Route 21 between Willow Pass Road and State Sign Route 4. Four interchanges are being constructed on this $3,984,000 contract; a half cloverleaf at Pacheco Boulevard-Sign Route 4 intersection, a full cloverleaf at the intersection of Sign Routes 4 and 21, a full diamond at Concord Avenue and a half diamond at Willow Pass Road. In addition, structures will be built on both Sign Routes 4 and 21 across Grayson Creek and at Center Street. Contra Costa County is contributing $63,000 for adjacent county road work. This project will complete 2.3 miles of freeway on State Sign Route 21 and approximately 1.2 miles of freeway on Sign Route 4. The contract is being performed as a joint venture by G. H. Ball and G. H. Ball Inc.



Revenue Bond Job

Between Arnold Industrial Highway (State Sign Route 4) and the Benicia-Martinez Bridge, construction is under way by Peter Kiewit Sons Co. to complete 3.9 miles of initial four-lane, future six-lane freeway to Escobar Street in Martinez. This $5,131,000 contract is financed from revenue bonds and calls for overcrossing structures at Blum Road and the East Martinez trumpet interchange. An underpass is being constructed at the Santa Fe Railroad in East Martinez and an overhead structure in the Mococo cloverleaf interchange over Escobar Street and the Southern Pacific Railroad. A half diamond interchange and the Arthur Road Undercrossing are being constructed at the approach to the bridge, which is expected to be completed in November of this year at a cost of $14,238,000.

During the past year, $474,000 was expended to grade and pave Howard and Escobar Streets between Berrellesa and Laguna Streets to provide a connection to the bridge approach from downtown Martinez and $62,500 was spent for resurfacing State Sign Route 21 between US 50 at Dublin and 0.2 mile north of the Alameda-Contra Costa county line.



Looking south along the future routing of Interstate 680 between Walnut Creek and Danville. Present Sign Route 21 generally parallels the routing to the right. Bids have already been opened on construction of the project.

US 40 (Interstate 80)

On US 40 (Interstate 80) two landscaping projects were completed during the past year. Between 0.3 mile south of El Cerrito Overhead and 0.3 mile south of Jefferson Avenue in Richmond, approximately $191,500 was expended to landscape 2.5 miles. It was completed in March of this year. In October of last year a $27,000 contract was completed for landscaping the Carquinez Bridge approaches and the Crockett Interchange.

Funds are budgeted for a $420,000 project for the construction of the Barrett Avenue offramp in Richmond on US 40. Presently under construction is a $89,000 contract for constructing 4.7 miles of median barrier between El Cerrito Overhead and San Pablo Road in Richmond.

Sign Route 24

In addition to the recently advertised contract between Monument Boulevard and Olivera Road previously discussed, funds are budgeted on State Sign Route 24 for 2.0 miles of eight-lane freeway between the east portal of Caldecott Tunnel and 0.4 mile west of Orinda Highway. Bid opening is June 20, 1962. Two interchanges will be constructed on this $7,500,000 project, a two-quadrant cloverleaf at Gateway Drive and connections to Fish Ranch Road at the east portal of the tunnel.

New Tunnel Bore

An additional two-lane bore is now under construction paralleling the two existing bores of the Caldecott Tunnel. Completion of this bore in 1964 will permit the use of four lanes for directional peak hour traffic. This 0.7-mile contract, including approaches will cost about $10,897,000 and is being performed as a joint venture by Connelly-Pacific Co., Grafe-Callahan Const., Brayer Electric Co. and Chas. L. Harney Inc.

Landscaping Completed

Two landscaping jobs were completed on the new freeway portions

f Sign Route 24 during the past year. n September, a 2.4-mile contract osting approximately $119,000 was ompleted between Orinda Highway nd West Sunnybrook Drive. Be-ween Pleasant Hill Road and Walden Road and Creekside Drive, a landscap-ng contract was completed in De-ember. This 4.5-mile project cost ap-roximately $232,000.

Other Contracts

On Sign Routes 4 and 24, $13,400 vas expended for traffic signals and hannelization islands at 18th Street nd "A" Street in Antioch. This work vas completed in September. $47,000 s budgeted to construct a truck pass-ng lane on Barry Hill and to chan-elize portions of State Sign Route 4 etween 0.3 mile south of McEwen Road and 0.2 mile east of Muir Road. This project includes the channeliza-ion at Muir Road at the entrance to he Veterans Administration Hospital.



Interstate 680 north of Concord looking toward the Benicia-Martinez Bridge.

MARIN COUNTY

Conversion of US 101 to full free-way standards between the Golden Gate Bridge and Hamilton Air Force Base is a step closer with the comple-ion of the Sir Francis Drake Boule-ard (Greenbrae) and Miller Creek Road interchanges during the past ear. In addition to this work, other mprovements were completed or udgeted to provide safer traffic serv-e on this heavily traveled thorough-are. Two additional projects are now udgeted for extending the freeway o State Sign Route 37 with an inter-hange at Ignacio.

US 101—Greenbrae to Ignacio

South of San Rafael, the third stage f construction on Greenbrae Inter-hange was completed in September. eter Kiewit & Sons Company, con-actor for this project, removed the d wooden bridge across Corte Ma-era Creek and erected a new struc-ure for the northbound off-ramp to r Francis Drake Boulevard. The reenbrae structures for freeway traffic were completed on two previ-ous contracts. This last $1,151,000 contract included reconstruction of Sir Francis Drake Boulevard and con-struction of ramps and frontage roads.

Work is presently under way on the reconstruction of the Auburn Street Railroad Underpass in the San Quentin Wye area south of San Ra-fael, a portion of the interchange front-age road arrangement. An amount of $115,000 is allotted for this work, which also provides for extending Woodland Avenue under co-operative financing with the County of Marin.

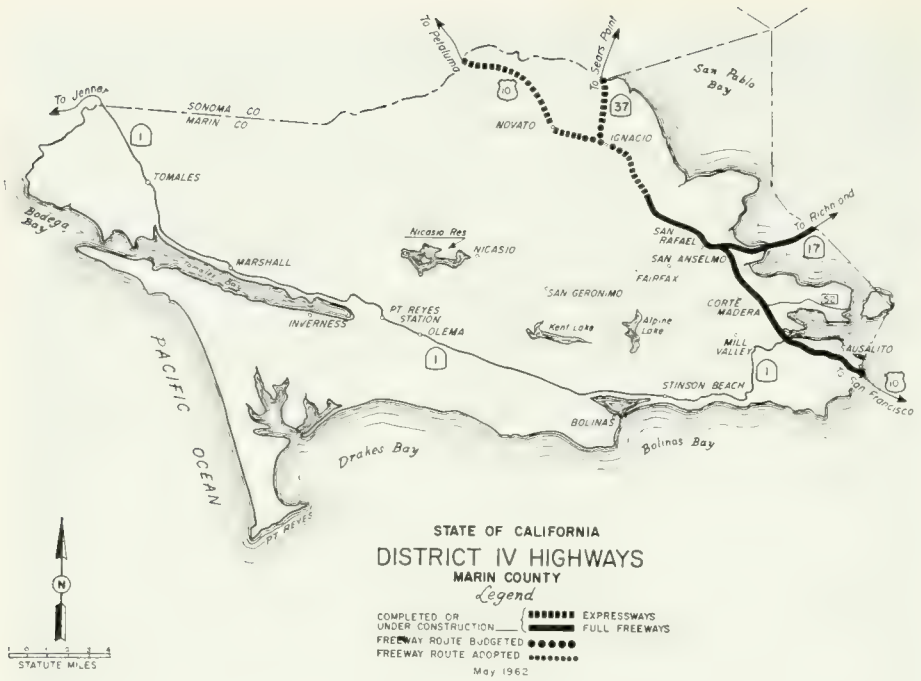
North of San Rafael, a $633,500 construction contract by Charles L. Harney, Inc. provided the initial con-struction of the Miller Creek Road Interchange. This work included wid-ening and resurfacing approximately 1.3 miles of freeway and the con-struction of the diagonal ramps of a future four-quadrant cloverleaf and two lanes of the ultimate four-lane overcrossing. This contract was com-pleted in October.

At Gallinas Creek near the north city limits of San Rafael, a $121,000 contract for culvert and channel lin-ing construction was completed in September. This work added addi-tional capacity and provided length to accommodate the ultimate eight-lane freeway width.

US 101—Novato

North of Novato, $139,000 was ex-pended to repair shoulder failures and construct drainage facilities between 2.2 miles north of Atherton Avenue and the Petaluma Creek Bridge. This contract was completed in January 1962.

Two major projects in the Novato area are in the current construction budget. One is the $3,500,000 project from Miller Creek Road to north of Entrada Drive to provide 2.7 miles of initial six-lane, ultimate eight-lane freeway with frontage roads. Inter-



changes at Pacheco Creek and San Jose Boulevard are included. Hamilton Air Force Base will be served from an easterly frontage road connecting the two interchanges. Auxiliary climbing lanes will be constructed over St. Vincents Hill for heavy truck traffic.

The second project is the $4,000,000 interchange at US 101 and Sign Route 37. Five structures, including the Northwestern Pacific Railroad Overhead, will be constructed. This is a directional type interchange except for the cloverleaf loop to be constructed in the northeast quadrant to serve US 101 northbound traffic to South Novato Boulevard. Considerable congestion now occurs at this signalized intersection caused by commute traffic and also recreational traffic from Sacramento, Russian River and Lake County resorts.

US 101—Golden Gate Bridge Area

One of several improvements programed for the Golden Gate Bridge Freeway (Waldo approach to the bridge) was completed last year with modification of the lighting on the county road connections at the Waldo Interchange. There is also a contract under way to modify the Golden Gate Bridge approaches to meet structure widening being done under Bridge District contract. $225,000 has been allotted for constructing lane transitions, installation of median barrier between the bridge and the Waldo Tunnel, adding a northbound lane from Vista Point to the Sausalito Road Undercrossing and an improved Sausalito Road channelization.

An amount of $200,000 is budgeted for improvement of Vista Point parking area at the northerly end of the Golden Gate Bridge. This project in-

BELOW LEFT—The Freitas Park overcrossing was completed last year. The development of suburban residential areas, such as Terra Linda on the left, warranted the replacement of the former signalized intersection on busy US 101. BELOW RIGHT—Looking north toward San Rafael in Marin County from above the recently completed Greenbrae Interchange.





cludes grading, paving, parking areas, landscaping and directional pointers naming important landmarks. A combination rubble masonry and redwood guard railing on the perimeter of the sidewalk around the parking area is included.

An $80,000 landscaping project for 1.7 miles of the freeway between Waldo Undercrossing and just north of Freitas Parkway and a $33,300 interim project to widen the northbound lanes between Lincoln Avenue Undercrossing and San Pedro Road are included in the budget.

Other Improvements

Construction is under way on State Sign Route 1 between Stinson Beach and Bolinas Road. This $137,600 contract is for re-constructing drainage facilities and resurfacing the existing two-lane conventional highway.

Bids were recently opened on a $540,000 contract near Mill Valley, on Tiburon Boulevard (State Highway Route 52), between US 101 at Alto Wye and 0.4 mile east of Strawberry Drive. The existing two-lane road will be replaced by a four-lane divided section with traffic signals at intersections.

NAPA COUNTY

Major highway development within Napa County in recent years has been generally confined to initial stage construction of two- and four-lane expressways on adopted freeway routes north, south and west of Napa. This steady improvement to modern highway standards continued during the past year with the completion of two contracts on State Sign Route 29 in the vicinity of Imola Avenue in Napa.

Freeway Construction

The first of these was completed last June at a cost of approximately $372,000. This contract included the construction of the Old Sonoma Road overcrossing, its approaches and frontage roads between Imola Avenue and 0.1 mile north of Old Sonoma Road. The second contract, completed in February, provided the interchange at Imola Avenue, including one mile of four-lane freeway to Old Sonoma Road. Included in the 1962-63 budget is $60,000 for functional planting within these limits.

Other Work on Sign Route 29

Two other contracts were recently awarded on Sign Route 29 and an additional project is budgeted. South of Napa, a contract has been let to resurface 2.6 miles of the southbound lanes between Imola Avenue and Kelly Road at a cost of $104,000, and construction is currently in progress on a $56,000 contract to construct three truck turnout lanes on Mount Saint Helena between Calistoga and the Lake County line.

Northwest of Napa, a $585,000 contract will be let to widen portions of existing Sign Route 29 to a 40-foot all-paved section between Dry Creek and Oakville. Construction of front-





The Imola Avenue Interchange in Napa where Sign Routes 12, 29 and 37 join.

age roads will be included in the southerly portion between Dry Creek and California Drive. Work will also include improvement of drainage facilities in cooperation with Napa County.

Sign Route 128

Two projects were completed on State Sign Route 128 northeast of Napa during the past year. $18,500 was expended for line changes to avoid slipouts near Lake Berryessa, about 6.1 miles east of the junction with Sign Route 37, and a $38,000 contract was completed in March of this year for reconstruction about 21 miles northeast of Napa. This year, $50,000 is budgeted for grading and paving of an 0.8-mile portion of Sign Route 128 between Pope Valley Road and the Monticello Dam relocation.

Sign Route 37

On Sign Route 37, $72,000 was expended by the State with an additional contribution of $16,000 by Napa County for realignment and widening of the existing two-lane highway between 3 miles and 12 miles northeast of Napa. Bids were opened May 31 for a $160,000 contract to widen this route at seven locations between Vichy Springs and Sign Route 128. A minimum 26-foot all-paved section will be constructed. Upon completion of the project, only about 2.5 remaining miles of the highway between Napa and Route 128 will require widening.

SAN FRANCISCO COUNTY

The major construction effort for the past few years, in the City and County of San Francisco, has been concentrated on the Southern Freeway. When complete, this freeway will connect James Lick Memorial Freeway (Bayshore Freeway) with the future Junipero Serra Freeway in Daly City.

The first unit was opened to traffic in July 1960, with the completion of the $7,565,000 interchange complex at the James Lick Freeway. The $4,273,000 unit between Mission Street and the completed interchange is presently under construction by Charles L. Harney, Incorporated. When completed in 1963, it will provide the first usable portion of the six-lane, ultimate eight-lane, freeway. Two major overcrossing structures, serving local traffic to and from Alemany Boulevard, are included, as well as overcrossings for Mission Street, Justin Drive, and a pedestrian bridge near Gladstone Drive.

Work started in December 1961 on the next unit extending from 1.1 mile west of Mission Street to Ocean Avenue. This $6,080,000 project was also awarded to Charles L. Harney, Inc., and consists in grading and paving for a six-lane freeway, constructing 13 traffic separations, pedestrian crossings and interchange structures, and nine retaining walls. Overcrossings are being constructed at Paulding Street and Baden Street, and pedestrian overcrossings will be provided at Theresa Street and Lamartine Street. The remaining nine structures will be overcrossings and undercrossings in the vicinity of San Jose Avenue, to furnish traffic service to San Jose Avenue, Monterey Boulevard, Bosworth Street and Lyell Street.

Ocean Avenue

The next project, extending from Ocean Avenue to Orizaba Avenue, will be under construction shortly, and is expected to be completed at about the same time. A total of $4,600,000 has been budgeted for it. Interchange facilities will be constructed at Ocean Avenue and ramps will be provided for traffic to and from San Jose Avenue in the vicinity of Plymouth Avenue. Major structures include overcrossings for San Jose Avenue in the vicinity of Broad Street and Mount Vernon Avenue, Geneva Avenue and Ocean Avenue. Under-

crossing structures will be constructed for the freeway and ramps at San Jose Avenue and Sickles Avenue, and pedestrian overcrossings are planned for Whipple Avenue and Havelock Street.

The first two units of the Southern-Embarcadero Extension Freeway have been budgeted. Construction of the double deck viaduct between James Lick Memorial Freeway and Newcomb Street should be underway this summer. A total of $5,500,000 has been budgeted for this construction, which will not provide a useable unit, however, until completion of the second unit between Newcomb Street and Army Street.

This second unit, scheduled for construction in 1963, will provide the transition from the double deck viaduct to a single deck viaduct, and freeway facilities to Evans Street, at a cost of approximately $5,580,000. An on-ramp will be built to Army Street.

During 1961 the route for the Southern-Embarcadero Extension was



he Southern Freeway on US 101 in San Francisco. The future location of the Southern-Embarcadero Freeway extension is shown in the background. The ortion between the James Lick-Southern Freeway Interchange and Mission Street is under construction and the right of way west of Mission Street has been cleared.



STATE OF CALIFORNIA
DISTRICT IV HIGHWAYS
SAN FRANCISCO COUNTY
Legend

COMPLETED OR UNDER CONSTRUCTION — EXPRESSWAYS / FULL FREEWAYS
FREEWAY ROUTE BUDGETED
FREEWAY ROUTE ADOPTED
May 1962

adopted by the California Highway Commission. When complete, this freeway will provide much needed relief to the Bayshore Freeway northerly of its interchange with the Southern Freeway.

Ramp Connections

Funds are budgeted in the amount of $1,470,000 and design is underway for additional ramp connections to the Embarcadero Freeway between Howard and Vallejo Street. These ramps will provide service to Clay and Washington Streets within the Golden Gateway Redevelopment area, which is scheduled for clearance early in 1963.

Three landscaping projects were completed during the past year on the James Lick, Southern and Central Freeways, and funds are budgeted for a similar project on the Embarcadero Freeway, between First and Stewart Streets. Eucalyptus trees were planted in the vicinity of the Southern-James Lick Freeway Interchange and acacia, tea trees, and other shrubs, were placed on this contract as well as the other two. Ivy plants and ice plant cuttings were used on these projects for ground cover.

SAN MATEO COUNTY

For many years the major demand for highway facilities was on the easterly side of the Peninsula, connecting the many suburban communities which had grown up along the Bay with San Francisco and San Jose. However, in recent years, a growing need for additional high standard, north-south arteries through the central, hilly portion and along the ocean coast, as well as east-west connections, has become more apparent.

19th Avenue Freeway

The first major step to fill the need for an east-west freeway is the present construction on State Highway Route 105 (19th Avenue Freeway) between West Hillsdale Boulevard and South Delaware Street in San Mateo. Eventually, this freeway will extend from Half Moon Bay to Hayward via the San Mateo-Hayward Bridge.

The unit presently under construction by L. C. Smith and Concar Ranch and Enterprises provides access to the new campus of the College of San Mateo. The 2.6-mile project will cost approximately $4,652,500 including contributions of $100,900 from the County of San Mateo, $76,500 by the Southern Pacific Railroad and $6,000 by the city. Four lanes are under construction between West Hillsdale Boulevard and El Camino Real, easterly of El Camino, a six-lane freeway will be constructed. Traffic separation structures and interchanges are being built at Alameda de las Pulgas, El Camino Real (US 101) and South Delaware Street, and an undercrossing will be constructed at Palm Avenue. This contract also includes an overhead crossing over the main tracks of the Southern Pacific Railroad near Pacific Boulevard.

Cabrillo Highway (Sign Route 1)

On State Sign Route 1, on the west coast, $3,850,000 is budgeted for a 3.2-mile, initial four-lane, ultimate six-

lane freeway between 1.1 mile south of Sharp Park Road and 0.4 miles north of Manor Drive in Pacifica. This project includes an interim channelization at Westport.

Overcrossing structures will be built on this contract at Sharp Park Road, Clarendon Avenue, Paloma Avenue and at Manor Drive. A full interchange will be constructed at Sharp Park Road and access ramps will be provided in the vicinities of Clarendon Avenue, Belle Vista Avenue, Milagra Drive and Monterey Road. Pedestrian separations will be built at Fairway and Milagra Drives.

South of Half Moon Bay on Sign Route 1 (Cabrillo Highway), work is under way on a $592,000 contract between 0.5 mile south of and 0.3 mile north of Tunitas Creek. The work includes construction of a new bridge across Tunitas Creek and improving the approaches.

El Camino Real (US 101)

Several contracts were completed on El Camino Real (US 101) during the past year, including major widening between Taylor Boulevard and Santa Helena Avenue in Millbrae. Approximately $254,000 was spent on this 0.8-mile project to widen the existing four-lane conventional roadway to a six-lane divided highway. Elsewhere, traffic signals and lights were installed or modified and channelizations constructed on two separate projects on El Camino Real. One location was at Broadway in Redwood City and the other between Menlo Avenue and Partridge Avenue in Menlo Park.

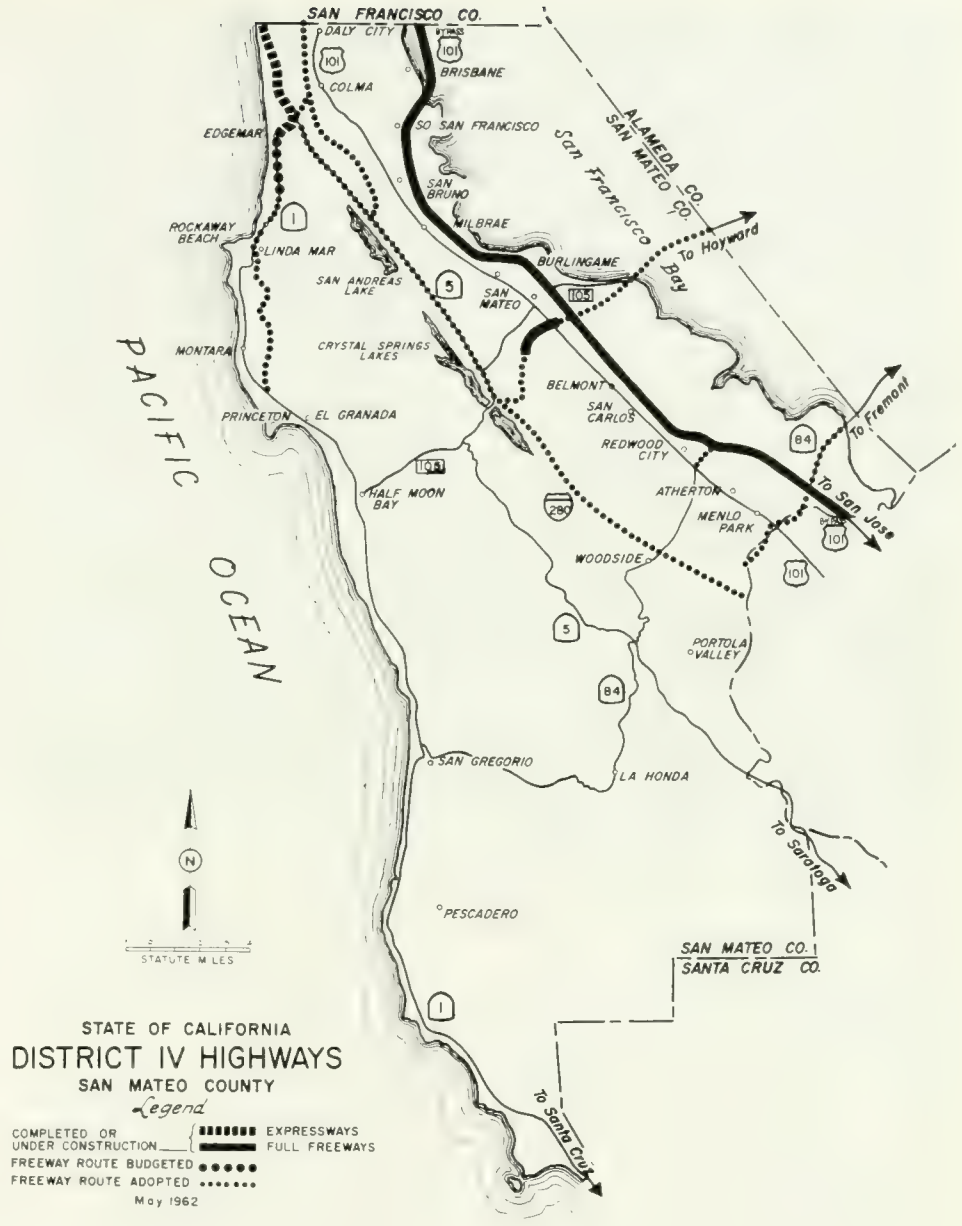
Funds are budgeted for 1.7 miles of widening on El Camino Real between Millwood Drive in Millbrae and Euclid Avenue in San Bruno. $530,000 has been budgeted for this project to widen the existing four-lane conventional roadway to a six-lane divided highway. $290,000 will be provided by the Cities of Millbrae and San Bruno to construct adjacent parking aprons and sidewalks and install street lighting.

US 101 Bypass (Bayshore Freeway)

The major improvement on Bayshore Freeway (US 101 Bypass) in San Mateo during this period was the completion of 7.5 miles of widening to eight lanes between Grand Avenue in South San Francisco and Peninsular Avenue in Burlingame. This $1,662,000 contract eased the severe peak-hour traffic congestion in the vicinity of the San Francisco International Airport. In addition to the widening and resurfacing of the existing traffic lanes to provide a smoother riding surface, the work included the construction of a diagonal ramp in the southwest quadrant of the Millbrae Interchange and improvement of ramps in the other quadrants. Double blocked out metal beam barrier was placed in the median on this project and 19 illuminated signs were installed. L. C. Smith was the contractor.

Presently under way is a contract for $280,000 for placing either cable chain link or blocked-out metal beam barrier on the remaining portions of Bayshore Freeway between Sierra Point Overhead near South San Francisco and Redwood Creek Bridge in Redwood City. Sign structures and sign lighting systems are also to be installed on the 17.4-mile project.

Bids were opened May 2 for resurfacing portions of US 101 Bypass between Buter Road in South San Francisco and Third Street Overcrossing





The 19th Avenue Freeway under construction in San Mateo. The future connection to the new San Mateo-Hayward Bridge, which will be constructed by the State Division of Bay Toll Crossings, is shown in the background.

in San Francisco. $420,000 is allotted for this 3.5-mile contract, which will provide a higher quality riding surface over the existing Candlestick fill cutoff.

Bayshore Landscaping

A $71,000 landscaping contract was completed in April of last year between 16th Avenue in San Mateo and Bransten Road in San Carlos.

Two additional landscaping contracts are under way; between Spruce Avenue in Redwood City and University Avenue in Palo Alto, 4.1 miles of Bayshore is being landscaped at a cost of $84,000. South of University Avenue to Natadero Creek, a 1.9-mile project will cost $61,400.

Projects were also completed or are budgeted on several of the other routes in the county. $42,700 was expended on a 0.2-mile realignment of State Sign Route 84 approximately three miles north of Woodside. Traffic signals and lights were installed and a channelization was constructed at Eastmore Avenue at the south city limits of Daly City on existing Junipero Serra Boulevard at a cost of $18,900.

An amount of $60,000 is budgeted for signals and channelization at the intersections of Sharp Park Road and Westborough Boulevard and Skyline Boulevard (State Sign Route 5). A channelization will also be constructed at the intersection of Skyline with Manor Drive and $28,000 is budgeted for this purpose.

Beaches and Parks

Funds are also budgeted for Division of Highways participation in the development of Thornton Beach State Park by the Division of Parks and Beaches. Bids were opened May 2 on this project for constructing a two-lane access road, parking areas, and a water and sewer system for this newly established metropolitan recreational area for picnicking, fishing, hiking and beach sport. The access road will utilize a large portion of relinquished State Sign Route 1 from Alemany Boulevard and the work includes 1,600 feet of resurfacing and 600 feet of realignment.

The major portion of the work, $85,000, is being paid by the Division of Parks and Beaches, the highway allotment being $25,000.

SANTA CLARA COUNTY

Highway development in rapidly-growing Santa Clara County has recently included completion of two contracts converting Bayshore Freeway (US 101) to full freeway standards and the recent award of the first contract for construction of Junipero Serra Freeway (Interstate 280). Other contracts were completed, are under way or are budgeted on US 101 to the south, the San Jose-Los Gatos Freeway, and on State Sign Route 9 in and near Mountain View.

Bayshore Freeway

Approximately 15 years after the first contract on the Bayshore Freeway was awarded, a continuous freeway extending 49 miles between San Jose and San Francisco has been completed. In December of last year, the first of two contracts on Bayshore was completed between Charleston Road in Mountain View and the Guadalupe River near San Jose. This work, performed by L. C. Smith and Concar Ranch and Enterprises, included construction of a freeway section on State Sign Route 9 from Bayshore Freeway to 0.2 mile east of Borregas Avenue, a $4,518,000 project.

The final gap in the freeway was closed in February as part of the second contract performed by Allan M. Campbell Company on a 6.1-mile section between Brokaw Road and Morse Avenue. This contract, completed in April of this year, cost approximately $5,672,000 and included eleven structures of four interchanges

and two grade separations. (For a detailed report on these two projects, see "Bayshore Freeway," by W. G. Remington, March-April 1962 issue of *California Highways and Public Works.*)

US 101—San Jose and South

Also completed during the past year was a contract for $51,500 for constructing a channelization and left turn lane at McKee Road interchange in San Jose.

South of San Jose on US 101 and US 101 Bypass, one contract was completed and two are under way. $896,000 is being expended to construct an overcrossing and interchange at Tully Road on US 101 Bypass. Between El Toro Avenue in Morgan Hill and Ford Road, the junction with US 101 Bypass, an $887,000 contract is in progress to widen and reconstruct existing US 101. This work includes drainage facilities and left turn lanes.

A $103,000 landscaping project is now in progress between Brokaw Road and Coyote Creek, in and near San Jose.

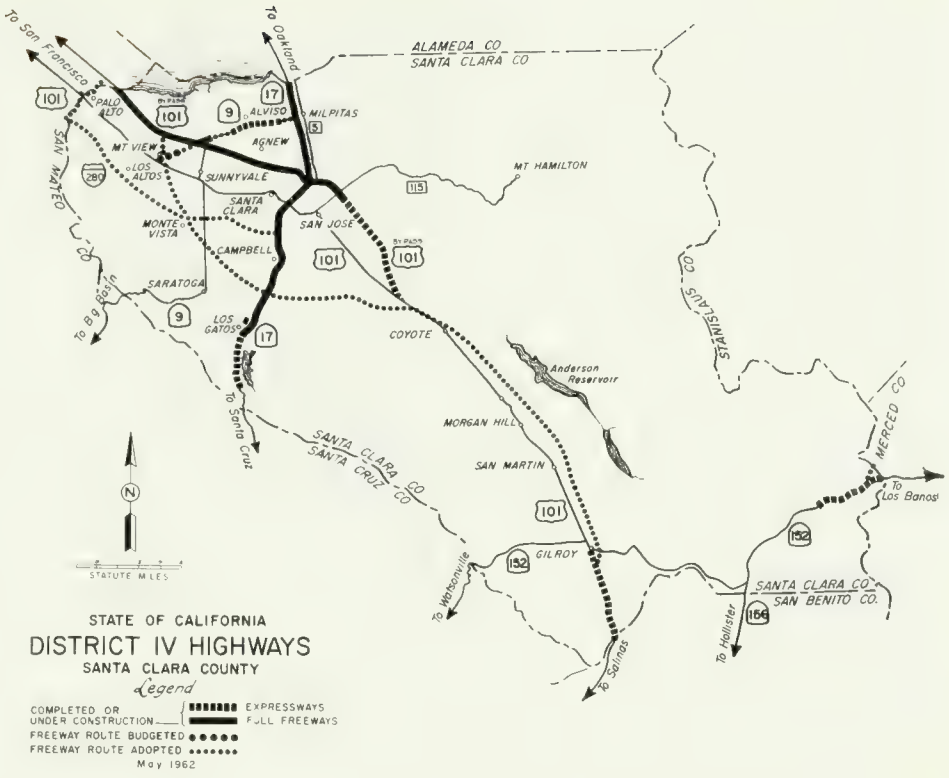
El Camino Real (US 101)

North of San Jose on El Camino Real (US 101), traffic signals and lights were installed and a channelization was constructed at Lincoln Street in Santa Clara. The City contributed approximately one-half of the funds for this $12,850 contract.

Farther north, in Palo Alto, a 2.1-mile project, costing $1,440,000, is under construction by McGuire & Hester, between University Avenue and Matadero Creek. El Camino Real is being widened from four lanes to a six-lane divided city street and the work includes installation of a lighting system, placing longitudinal storm drains, and landscaping median islands. The existing Mayfield Avenue pedestrian undercrossing is being extended.

Junipero Serra Freeway

An amount of $1,200,000 is budgeted to widen existing State Sign Route 17 freeway to six lanes between Forest Avenue and Bayshore Freeway. Coleman Avenue Interchange will be reconstructed as a part of this work.



The first contract on Junipero Serra Freeway (Interstate 280) was recently awarded. It includes grading and paving 4.3 miles of freeway between State Sign Route 17 freeway and west of Saratoga Avenue and adding an additional lane on the inside of existing Sign Route 17 between Moorpark Avenue and Forest Park Avenue. This $4,750,000 contract will modify the existing full cloverleaf interchange at Stevens Creek Road and Sign Route 17 to accommodate collector roads and direct connections to Junipero Serra freeway. Interchanges will also be constructed at Santa Clara-Los Gatos Road and at Saratoga Avenue. Two pumping plants and two pedestrian separations will be built and eleven traffic structures will be constructed or modified. (An extensive account of the planning and design studies for the Junipero Serra Freeway was published in the January-February 1962 issue of *California Highways and Public Works.*)

Sign Route 17

On State Sign Route 17 westerly towards the Santa Cruz county line, $9,700 is to be expended to widen the existing highway and install guard rail. Two other contracts were completed on Sign Route 17 in Campbell. The southbound freeway off-ramp was widened and signals installed at Hamilton Avenue at a cost of $25,300. Lighting, signals and channelization were constructed at Camden Avenue at a cost of $53,800.

In San Jose, a 2.6-mile landscaping contract is under way between Bascom Avenue and Bayshore Freeway. Twelve hundred trees, 5,200 shrubs and 363,000 ground cover plants are being placed on the $176,-200 contract; along with an irrigation system.

Sign Route 9

On State Sign Route 9, $408,000 was expended on improvements between 0.2 mile east of San Jose-Alviso Road and Nimitz Freeway. This project, completed in January, included 2.1 miles of widening and realignment to eliminate sharp curves in the former highway. A major portion of the line change will serve as the northerly lanes of a future freeway. As a part of the work, a new bridge was constructed across Coyote Creek. In Sunnyvale, traffic signals and highway lighting were installed

and channelizations were constructed at the intersection of State Highway Route 113 with Java Drive-Fair Oaks Avenue and at Caribbean Drive-Lawrence Station Road at a cost of $21,650. West of Saratoga, 3.1 miles of shoulders were reconstructed and resurfacing placed at a cost of $86,100.

Funds are budgeted for two projects on Sign Route 9, one at the Middlefield overcrossing structure and approaches in Mountain View on the route of the future Stevens Creek Freeway. Between El Camino Real (US 101) and 0.4 mile north of the Southern Pacific Railroad near Bernardo Avenue in Mountain View, $1,475,000 is budgeted for a project which will provide a four-lane expressway from El Camino Real to Church Street, a four-lane divided freeway between Church Street and Sylvan Avenue and a two-lane conventional highway between Sylvan and Bernardo Avenues. An interchange will be constructed at Dana Street and structures will be built at Stevens Creek and East Mountain View overhead. The latter will be two-lane and eliminate the present grade crossing. The portion between Stevens Creek and Sylvan Avenue will be depressed.

A contract was recently awarded for widening Sign Route 9 from two to four lanes on the 5.4 miles between the railroad crossing at Azule and El Camino Real in Sunnyvale with signals and left-turn storage lanes at Prospect Avenue, Bollinger Road, Stevens Creek Road, Homestead Road and Fremont Avenue. $740,000 has been allotted for this project.

Other Projects

A little more than four miles of Sign Route 152 was widened and resurfacing was completed in September between San Felipe and Bell's Station at a cost of $200,000. Drainage facilities were also reconstructed east of Prunedale Avenue near Gilroy on this route at a cost of $19,900.

Funds are budgeted for widening Jones Creek Bridge east of Gilroy on Sign Route 152 and bids were opened in May for installing underdrains at a cost of $30,000 between 2.6 miles north of State Highway Route 42 near Saratoga gap and the San Mateo county line on State Sign Route 5.

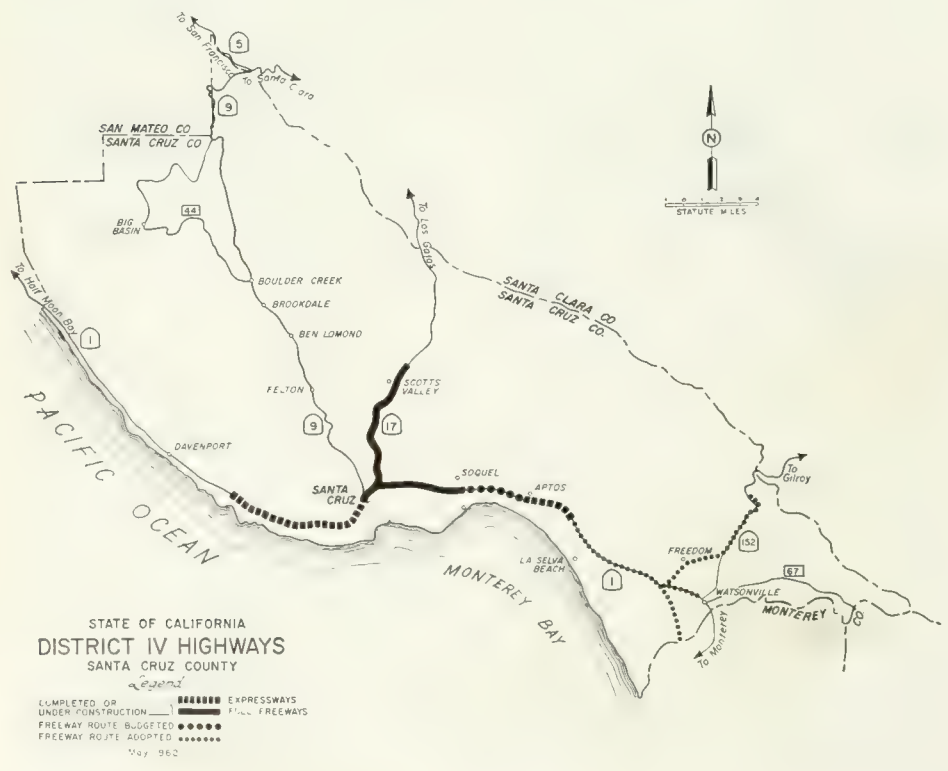
SANTA CRUZ COUNTY

The first contract to convert the existing State Sign Route 1 expressway between Santa Cruz and Rob Roy Junction to full freeway standards was completed by L. C. Smith in January of this year.

A two-quadrant cloverleaf was constructed at 41st Avenue and a frontage road was built from South Rodeo Gulch Road to 17th Avenue. This 1.5-mile contract between Soquel Wharf Road in Capitola and Soquel Avenue was completed at a cost of about $594,000.

A similar project between 0.2 mile west of Aptos Creek and 0.3 mile east of Soquel Wharf Road is budgeted for early construction. A two-quadrant cloverleaf interchange will be constructed at State Park Drive and a diamond interchange will be built at Park Avenue. This 2.9-mile project will cost approximately $1,250,000 and will include frontage roads.

An amount of $180,000 is budgeted for repaving 7.1 miles of State Sign Route 1 between Rob Roy Junction and Main Street in Watsonville. North of Watsonville, a contract was completed to reconstruct the base and resurface 18 miles between south of Davenport and Princeton. This $448,000 project was required to repair damage to Sign Route 1 resulting from the hauling of large rock for constructing the Pillar Point breakwater.



Sign Route 17

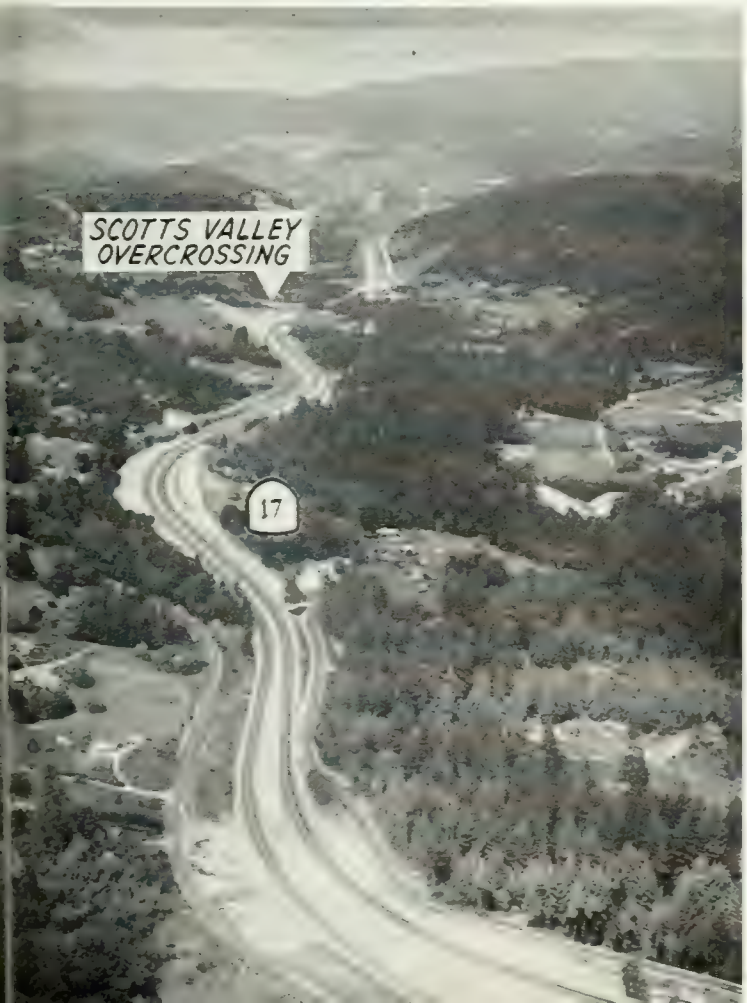
On State Sign Route 17, a three-mile section of four-lane freeway was completed between Granite Creek and Glen Canyon Road by Edw. Keeble Construction Co. The completion of this contract provides a combination freeway-expressway on Sign Route 17 beginning in the vicinity of Santa's Village and terminating in Santa Cruz. This relocation bypasses the former three-lane highway through Scotts Valley, which will continue to serve local traffic. Interchanges were constructed at Granite Creek and Glen Canyon and an over-

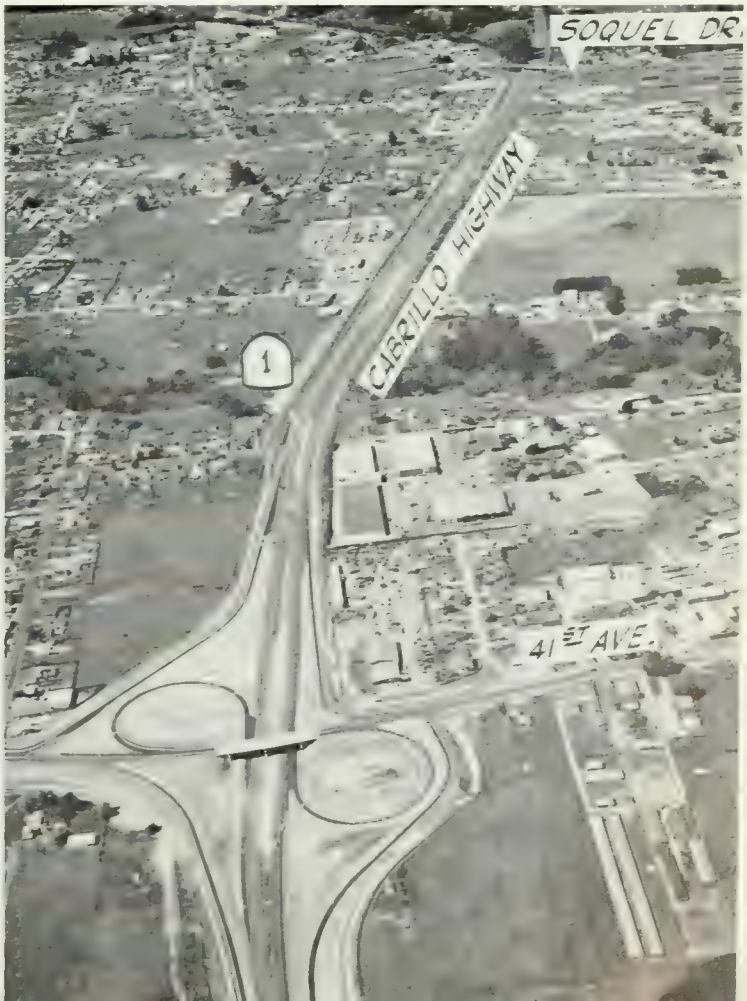


PHOTO ABOVE—The newly completed section of US 101 Bypass (Bayshore Freeway in Santa Clara County between Morse Avenue and Charleston Road. BELOW—Typical freeway-expressway development through forested foothill terrain on Sign Route 17 between Santa Cruz and Los Gatos.



PHOTO ABOVE—Looking east toward the Nimitz Freeway on Sign Route 9 at the Coyote Creek Bridge in Santa Clara County. BELOW—Looking toward Santa Cruz from the 41st Avenue Interchange near Soquel. This is the first contract for converting Sign Route 1 expressway to full freeway.





crossing was built at Scotts Valley Road. This contract cost $1,288,000.

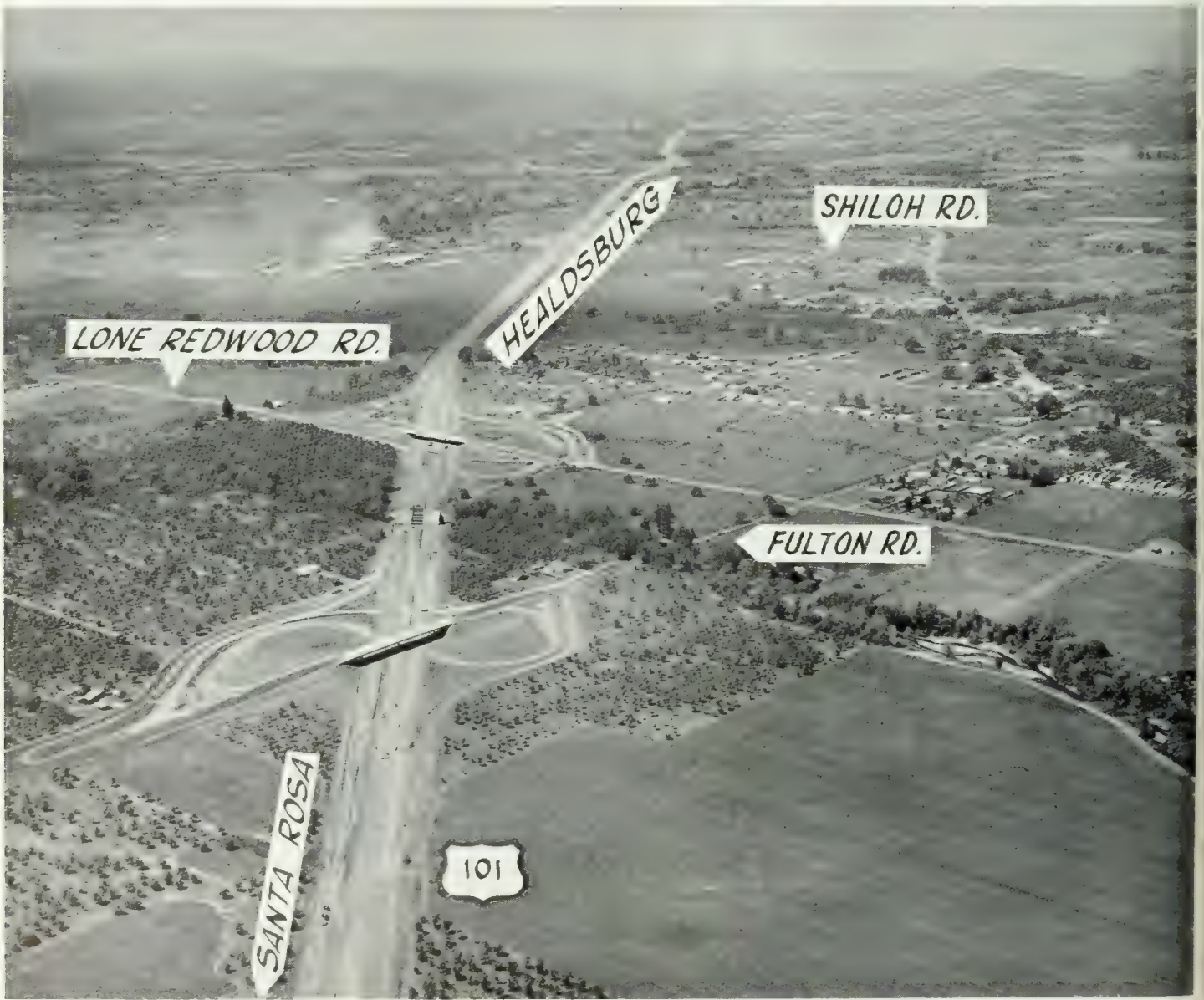
Currently under construction is a contract for replacing base and resurfacing on portions of the 6.4 miles of State Sign Route 17 between Granite Creek and the Santa Clara county line. Drainage improvements are also included in this half-million dollar contract being performed by L. C. Smith Co. Funds amounting to $160,000 are budgeted for functional planting and trees between State Sign Route 1 and Granite Creek Road.

In July a $239,000 contract was completed to realign 1.2 miles of State Highway Route 67 (Chittenden Pass Road), between 1.8 miles and 3.0 miles east of Watsonville. This work included construction of a new bridge across Coward Creek.

SONOMA COUNTY

The recent award of the 5.5-mile contract for State Sign Route 12 between Occidental Road and South E Street, in and near Santa Rosa, was another important step in the development of major traffic routes within Sonoma County to freeway standards. This project, together with freeway contracts on US 101 recently completed, under construction, or budgeted, will insure improved and safer travel conditions for the motoring public.

State Sign Route 12 will be constructed to a four-lane expressway on new alignment between 0.4 mile west of Occidental Road and the vicinity of Dutton Avenue in Santa Rosa, and as an initial four-lane ultimate six-lane freeway from Dutton Avenue to South E Street plus grading work for



Construction on the Redwood Highway between north of Santa Rosa and Windsor. Completion of this work and another contract immediately to the north will provide a minimum four-lane divided highway for 74 miles on US 101 between the Golden Gate Bridge and Lytton.



another 1.2 miles easterly. In addition to the Northwestern Pacific Railroad, separations are being provided at Olive Street, Santa Rosa Avenue and Dutton Avenue, and a three-level interchange will be constructed at US 101. This $5,200,000 contract is being performed by Peter Kiewit Sons Co.

Completion of this project will eliminate the most congested intersection on US 101 in Sonoma County and will provide the first portion of planned free-flowing traffic facilities for the Santa Rosa area, linking the major east-west and north-south freeways. Projects for extending Sign Route 12 on to Kenwood are under design study and the California Highway Commission in May adopted a freeway route from Kenwood to a junction with Sign Route 37 in the vicinity of Schellville.

Redwood Highway—US 101

Two major projects on US 101 expected to be opened to traffic this fall will complete the Redwood Highway to full freeway standards between the Marin county line and Lytton, northerly of Healdsburg, except for portions south of Petaluma River and within Santa Rosa.

A 9.6-mile contract, costing approximately $4,386,000, from the north city limits of Santa Rosa to Grant Creek includes full interchanges at Mendocino Avenue, East Fulton, Fulton, Lone Redwood and Shiloh Roads, and a partial interchange at Windsor. On this contract, performed by Guy F. Atkinson Company, the freeway is being paved to Windsor and was rough graded from there to Grant Creek.

The second project for constructing five miles of freeway between Windsor and Healdsburg includes paving the aforementioned rough graded section and constructing interchanges or separations at Windsor, Arata Lane, Limerick Lane and south of Healdsburg near Grant Avenue. This work is being done by Ball and Simpson at a cost of $3,020,000.

North of Lytton, almost 10.0 miles of the existing highway has been resurfaced and $2,400,000 has been budgeted for a 3.5-mile freeway project through the Asti area between Washington School Road and north of Hiatt Road.

Interim Project

Bids were opened May 9 for the interim contract to improve 0.8 mile of State Sign Route 12 between Farmers Lane and Brush Creek in Santa



Substructure construction of a cast-in-place, reinforced concrete, box girder bridge over Austin Creek in Sonoma County on the alignment of Sign Route 12 between Austin Creek and Duncan Mills.

Rosa to a four-lane conventional highway. This project will serve traffic until the freeway is completed easterly to Melita. It is a co-operatively financed project with the City of Santa Rosa providing funds for the rights-of-way and contributing $20,000 to construction costs, and Sonoma County Flood Control and Water Conservation District contributing $50,000 and right-of-way for channel improvement in addition to the $175,000 budgeted by the State.

Other Construction

West of Guerneville, construction is under way on Sign Route 12 to provide 1.9 miles of conventional highway on new alignment between Duncans Mills and Austin Creek. This $680,000 project will replace the narrow, steep, tortuous alignment and will provide a new bridge at Austin Creek.

On State Sign Route 1 along the coast three minor projects between Fort Ross and Jenner were completed during the past year for realignment around slipouts, installing culverts and grading and surfacing.

STATUS OF DISTRICT IV FREEWAY AND EXPRESSWAY PROJECTS

Description	Total miles	Completed projects		Under contract		Budgeted		Right of Way expended and budgeted
		Miles	Construction cost	Miles	Construction cost	Miles	Construction cost	
U.S. 101 AND 101 BYPASS								
Bayshore and James Lick Memorial Freeway, U.S. 101 Bypass; Southern Freeway in San Francisco to Ford Road South of San Jose	52.9	46.8	$53,749,000	6.1	[a]$6,716,000	------	$855,000	$25,382,341
Southern Freeway	4.7		[b]7,312,000	2.4	10,414,000	1.8	4,600,000	20,132,965
James Lick Memorial Freeway	3.0	3.0	11,438,000					12,870,440
Central Freeway	1.8	1.8	11,653,000					8,531,116
Golden Gate Freeway	1.1					1.1	5,100,000	83,097
Ford Road South of San Jose to San Benito County Line	27.9	5.8	1,093,000					545,839
Southern Freeway Ext. near South City Limits of San Francisco (Rte. 68) to Rte. 224 near the San Francisco-Oakland Bay Bridge	4.4					1.4	11,080,000	3,535,000
Redwood Freeway; Golden Gate Bridge to Mendocino County Line	84.3	58.0	[c]43,841,000	11.0	7,680,000	3.5	10,395,000	17,555,070
U.S. 40								
San Francisco to Carquinez Bridge (portions)	18.2	18.2	[d]61,976,000	------	89,000	------	420,000	13,284,971
U.S. 50								
MacArthur Freeway; Distribution Structure to Castro Valley	15.3	1.1	4,115,000	5.7	19,534,000	6.1	17,065,000	53,533,107
Castro Valley to San Joaquin County Line	31.4	31.4	11,647,000					4,250,000
SIGN ROUTE 17								
Nimitz Freeway; Distribution Structure to Bayshore Freeway at San Jose	41.3	41.3	55,688,000	Add lanes	4,487,000	------	485,000	22,464,786
Santa Cruz to San Jose (portions)	19.9	19.9	17,105,000	------	176,000	------	660,000	9,825,985
U.S. 40 near Albany to U.S. 101 near San Rafael (portions)	9.9	2.2	1,973,000	------		------		2,614,898
SIGN ROUTE 9 AND 21								
Warm Springs to U.S. 50	17.7	------		------		4.7	6,200,000	1,838,913
U.S. 50 to Walnut Creek	16.0	3.5	3,010,000			6.8	12,900,000	10,615,281
Walnut Creek to Monument	3.4	3.4	9,236,000	------		------		6,412,772
Monument to Solano County Line	7.4			5.4	[e]11,243,000	2.0	1,800,000	4,732,254
Sign Route 9 North of Route 21 in Fremont	4.4			------				28,465
GROVE-SHAFTER FREEWAY ANG SIGN ROUTE 24								
Sign Route 17 in Oakland to Warren Boulevard	4.8			------		------		12,359,441
Warren Boulevard to Walnut Creek	11.0	6.4	9,725,000	1.1	11,584,000	3.1	10,215,000	5,528,651
North of Monument to Sign Route 4, Concord	3.4		226,000			3.2	3,150,000	1,823,273
EMBARCADERO FREEWAY	1.5	1.5	14,792,000			Add R	amps 1,470,000	12,628,424
PARK-PRESIDIO FREEWAY; GOLDEN GATE BRIDGE TO FULTON STREET	2.1	1.2	1,448,000					70,000
JUNIPERO SERRA FREEWAY								
Sign Route 17 to San Francisco County Line	43.9					4.7	5,950,000	19,417,159
Stevens Creek-West Valley Freeways	23.6							5,921,596
CABRILLO HIGHWAY								
Moss Beach to Lake Merced Boulevard in San Francisco	17.0	5.4	2,766,000	------		3.2	3,817,000	7,765,051
Watsonville to 4 miles South of Davenport (portions)	22.8	13.9	7,523,000	------		2.9	1,250,000	3,860,376

STATUS OF DISTRICT IV FREEWAY AND EXPRESSWAY PROJECTS—Continued

Description	Total miles	Completed projects		Under contract		Budgeted		Right of Way expended and budgeted
		Miles	Construction cost	Miles	Construction cost	Miles	Construction cost	
JUNIPERO SERRA FREEWAY TO NIMITZ FREEWAY								
19th Avenue Freeway, Junipero Serra Freeway to Alameda County Line at San Mateo Bridge (portions)	8.0			2.3	4,800,000			5,823,518
San Mateo County Line to Nimitz Freeway	6.8							426,000
PACHECO PASS: 1 MILE EAST OF BELL'S STATION TO MERCED COUNTY LINE	5.3	5.3	1,285,000					12,393
WEST OF U.S. 101 TO BYPASS U.S. 101 IN REDWOOD CITY (ROUTE 214)	1.1							2,513,802
MOUNTAIN VIEW—ALVISO FREEWAY; EL CAMINO TO NIMITZ FREEWAY	10.5	5.5	2,088,000			1.5	1,475,000	2,905,050
FREEWAY CONNECTION FROM NIMITZ FREEWAY TO U.S. 50 (ROUTE 228)	2.2	2.2	2,803,000					2,236,000
BAY FARM ISLAND BRIDGE AND APPROACHES	0.6	0.6	2,062,000					165,000
WEBSTER STREET TUBE	1.1		203,000	1.1	17,363,000		1,400,000	2,613,669
WARREN BOULEVARD FREEWAY; SIGN ROUTE 24 NEAR LAKE TEMESCAL TO MACARTHUR FREEWAY	5.6	4.1	[5,654,000		1,292,000	0.6	600,000	2,255,652
SHEPHERD CANYON FREEWAY; WARREN BOULEVARD FREEWAY TO SIGN ROUTE 24	10.3							689,443
ARNOLD INDUSTRIAL FREEWAY; HERCULES TO ANTIOCH BRIDGE (SIGN ROUTES 4 AND 24	34.1	14.7	4,694,000					1,806,073
SIGN ROUTE 12; SEBASTOPOL TO KENWOOD	17.7					4.1	5,220,000	5,774,394
SIGN ROUTE 29; SOLANO COUNTY LINE TO CALISTOGA	36.9	23.2	4,703,000				485,000	4,182,514
SIGN ROUTE 37; FROM REDWOOD FREEWAY AT IGNACIO TO NAPA	13.4	7.2	5,900,000					777,903
Totals	648.7	327.6	$359,708,000	35.1	$95,378,000	50.7	$106,572,000	$519,792,686

(a) Includes $300,000 contributed by co-operating agencies.
(b) Includes total of $1,600,000 by City of San Francisco.
(c) Includes total of $5,000,000 by Golden Gate Bridge and Highway District.
(d) $29,117,000 Toll Bridge Funds in this amount.
(e) $6,833,000 from Toll Bridge Funds.
(f) City of Oakland and Alameda County contributions included in this figure.

DESIGN ENGINEER JOHN CREED RETIRES IN BISHOP

John H. Creed, Design Engineer for District IX (Bishop), retired June 1 after 34 years of service with the Division of Highways. His first engineering job was as chainman on tunnel construction for the Southern California Edison Company in 1922.



JOHN H. CREED

He joined the division in 1928 as a Junior Highway Engineer. He served in various engineering assignments in Districts I (Eureka), II (Redding), and IV (San Francisco).

He was promoted to senior highway engineer in 1949 and assigned as Design Engineer of District IX. He supervised the location and design of the U.S. 395 relocation over Sherwin Grade.

A native Californian, Creed attended grade school at Pescadero, high school in Oakland and studied at Stanford University.

He is a member of the American Society of Civil Engineers and is an Elk and a Mason. He has been active in Boy Scout work.

He is married and has a daughter, Mrs. Margaret Furber, of Klamath Falls.

Creed has accepted an appointment as County Engineer of Klamath County in Oregon with headquarters in Klamath Falls.

MOUNTAIN ROUTES OPENED

The Division of Highways reported the following road openings in April: Fallen Leaf Lake Road, April 10; June Lake Loop, north leg, April 13; Sign Route 89, Emerald Bay Section, April 18; Sign Route 120, Big Oak Flat road in Yosemite National Park, April 20; Sign Route 120, Mono Hills Section, April 24; Sign Route 89, Monitor Pass Section, April 26.

Route Adoptions

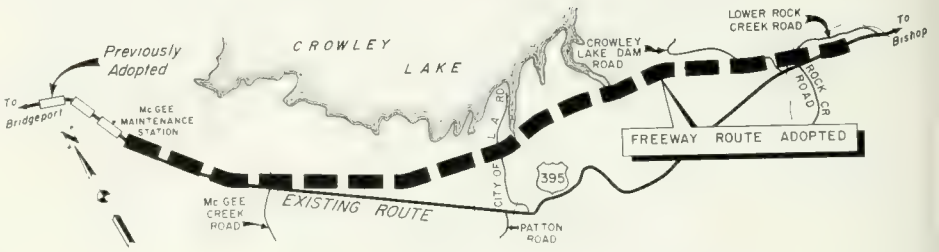
March, April Freeway Routings Total 62 Miles

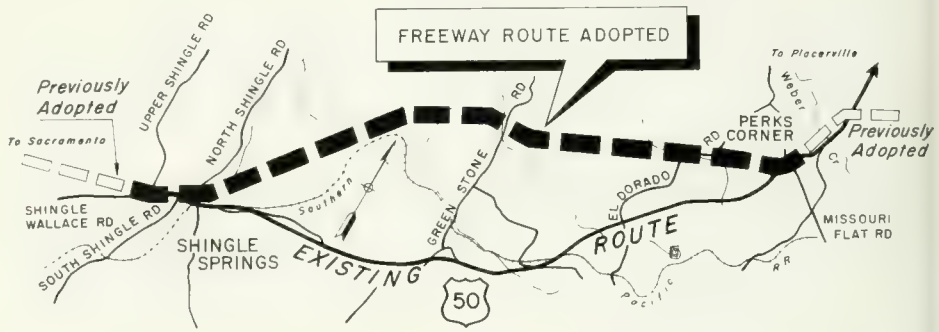
The California Highway Commission adopted routings for seven sections of freeway totaling 62 miles in length at its March and April meetings. This brings the total mileage of freeway routes adopted to 6,066, or approximately one-half of the length of the 12,400-mile California Freeway and Expressway System.

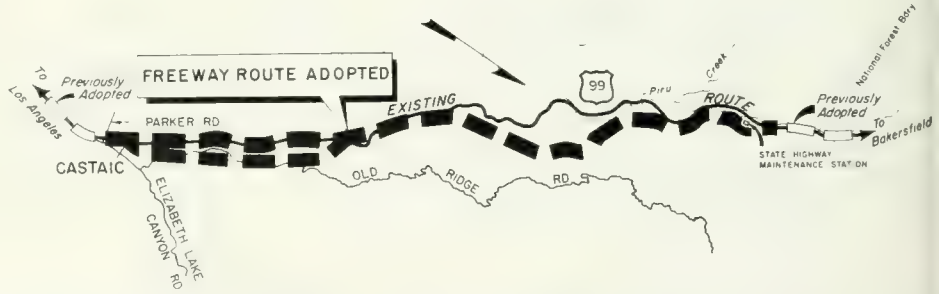
The commission also adopted routings for four sections of conventional highway.

The freeway route adoptions ranged from central California to San Diego, and included two on which the commission had held public hearings in addition to the public hearings held by the Division of Highways.

In one of these, a routing for 6.4 miles of State Highway Route 107 in San Mateo and Santa Clara Counties and the cities of Menlo Park and Palo Alto, the commission adopted a route differing in part from that recommended by State Highway Engineer J. C. Womack.

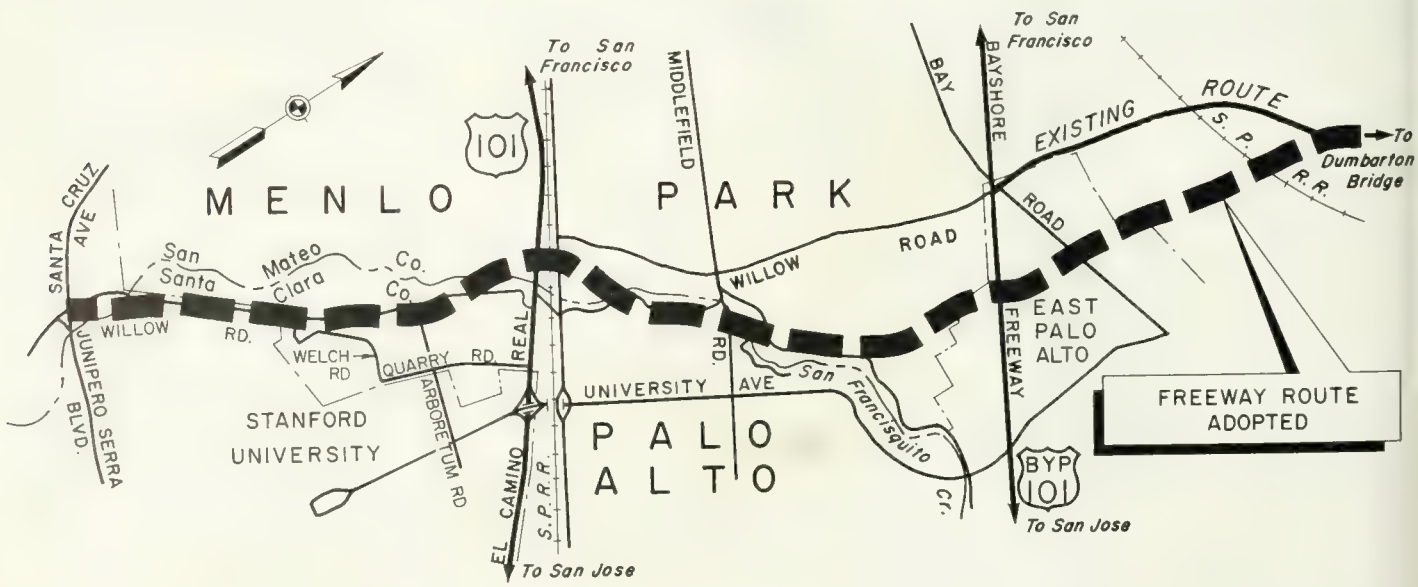


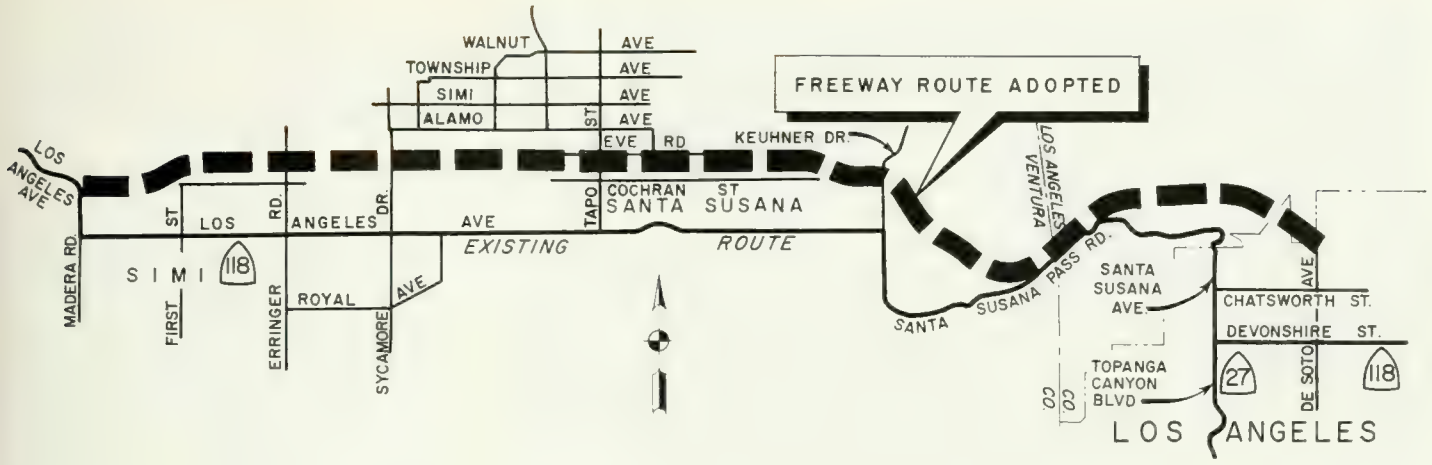




East-West Routing

This highway will be an east-west route and the section adopted in March runs from the Dumbarton Bridge to Santa Cruz Avenue, east of Willow Road between the Dumbarton





Bridge and El Camino Real and then generally along the line of Willow Road.

The other route on which the commission held a public hearing is for the relocation of 8.3 miles of US 395 in Mono County in the vicinity of Crowley Lake. The commission adopted the recommended route which runs north of the existing highway on a line which is more direct than the existing highway and about seven-tenths of a mile shorter.

Other freeway routes adopted:

El Dorado County—for the relocation of 6.9 miles of US 50 between 0.8 mile west of Shingle Springs and Missouri Flat Road at Perks Corner.

Los Angeles County—for the relocation of 17.9 miles of US 99 between Parker Road in Castaic and three-fourths of a mile north of the Ridge Route Maintenance Station.

San Diego County—for 2.8 miles of State Highway Route 283 in San Diego on Wabash Boulevard between US 101 and the adopted freeway route for State Highway Route 241 near Nile Street.

Santa Barbara County—for the relocation of 7.5 miles of Sign Route 1 between US Highway 101 near Las Cruces and San Julian Ranch.

Highway Relocation

Ventura and Los Angeles Counties—for the relocation of 12.5 miles of Sign Route 118 (Los Angeles Avenue and Santa Susana Pass Road) in Ventura and Los Angeles Counties and the Chatsworth area of the City of Los Angeles.

The conventional route adoptions include a route for a section of Sign Route 29 in Lake County north of Middletown, a route for a minor relocation of Sign Route 132 at Tarantula Creek in Stanislaus County and for Sign Route 36 in Humboldt County near Carlotta, four miles east of Alton.

District V Loses Mark L. Cardwell

Highway Superintendent Mark L. Cardwell retired June 1 from the Division of Highways district office in San Luis Obispo. He was with the division 34 years.


MARK L. CARDWELL

Promoted to superintendent in 1940, he first served in District VI (Fresno) and later at Buellton, Salinas, Cambria, Paso Robles and finally San Luis Obispo in the District V area.

Cardwell was born in Noblesville, Indiana, where he attended grade school. He went to high school at Westfield and came to California in 1913.

He served in the U.S. Army from 1917 to 1920 and joined the California Division of Highways as a power shovel operator in 1928, working first in the Carmel and Big Sur area. He was promoted to foreman in 1935 and assigned to the Santa Maria area.

The Western Association of State Highway Officials will hold its 11th annual planning conference in San Francisco on July 12th and 13th.

Seattle Public Library
JUL 9 1962

Progress Reported On Bridge Projects

The Division of Highways reports progress on five bridge and tunnel projects as follows:

Webster Street Tube—Eighty-five percent of the work completed; estimated completion date January 1963.

San Pedro-Terminal Island Bridge—Substructure expected to be completed in July. On superstructure the erection of the main steel for the Terminal Island tower has been completed.

Randolph Collier Tunnel—The project is 48 percent complete; estimated completion date is January 1963.

Caldecott Tunnel—The project is 20 percent complete and the estimated completion date is January 1963.

Benicia-Martinez Superstructure—The contract is 92 percent complete and estimated completion date is November 1962. The substructure was completed in January.

The Division of San Francisco Bay Toll Crossings reported that reconstruction work on the upper level of the San Francisco-Oakland Bay Bridge through Yerba Buena Island Tunnel is now 50 percent complete.

Goleta Project

Last Two-lane U.S. 101 Section in South Santa Barbara County is Eliminated

By ROY E. ALDERMAN, District Construction Engineer



WITHOUT fanfare or ceremony, but with considerable public satisfaction, the remaining eight miles of two-lane highway on US 101 in southern Santa Barbara County were eliminated by recent completion of a modern four-lane divided freeway from the west city limits of Santa Barbara westerly to Elwood Station.

The general area surrounding this freeway location, was until recently, principally devoted to citrus and walnut orchards and diversified farming. It is now in a transition stage with the orchards and farms rapidly disappearing, to make way for extensive residential, commercial and light industrial growth. Most of the light industry is concentrated in the vicinity of the Santa Barbara airport at Goleta which is immediately south and toward the ocean from this project. The University of California at Santa Barbara is located in this general vicinity and the campus is expanding at a great rate, further complicating the traffic problems in this area.

The Fairview overcrossing (center front) connects U.S. 101 with the University of California at Santa Barbara. The view is westward.



Two Lanes Inadequate

The existing two-lane highway, although on excellent alignment and grade, was woefully inadequate to handle the increasingly heavy traffic volume in this rapidly expanding area. In addition to the heavy flow of traffic on US 101, there were additional complications arising from the fact that there are a total of 10 heavily-traveled county roads which crossed or terminated with US 101 at inopportune points where interference with through traffic would be a major factor. This problem was also complicated by numerous, often used, private road approaches all along this eight-mile section, and by hazards caused by the presence of numerous railroad crossings of county roads at grade.

A combination of all these factors contributed to a high accident rate, most of which were of a noncollision or rear-end type. The most commonly reported causes of vehicle accidents were speeding, following too closely and improper passing. Also, nearly one-third of the vehicles involved were those either attempting to make a left turn onto the existing two lanes from county and private roads or vehicles making a left turn from the highway to various crossroads. Completion of this four-lane divided freeway has naturally eliminated these most commonly reported types of accidents.

Traffic, Growth Factors

The traffic and area growth factors, plus the increasing high cost of real estate in this area, dictated the selection of the existing route as the logical location for the freeway.

It was possible to salvage most of the existing roadway, which was used as a larger portion of the left or southbound lanes. To accommodate the interchanges, it was necessary to move some of the existing alignment slightly to the north away from the railroad. This provided room for construction of southbound on-off ramps of the interchanges.

Provision was also made for an interchange at US 101 with the Clarence Ward Memorial Freeway leading to the University of California at Santa Barbara campus.

To minimize construction costs and interference with traffic during future construction, the approach fills for the Clarence Ward Memorial Freeway were constructed as an integral part of this freeway project. Initial construction on the Clarence Ward Memorial Freeway began late in August 1961, more than a year after construction of this portion of US 101 freeway, and work on this interchange is proceeding nicely without interference to traffic.

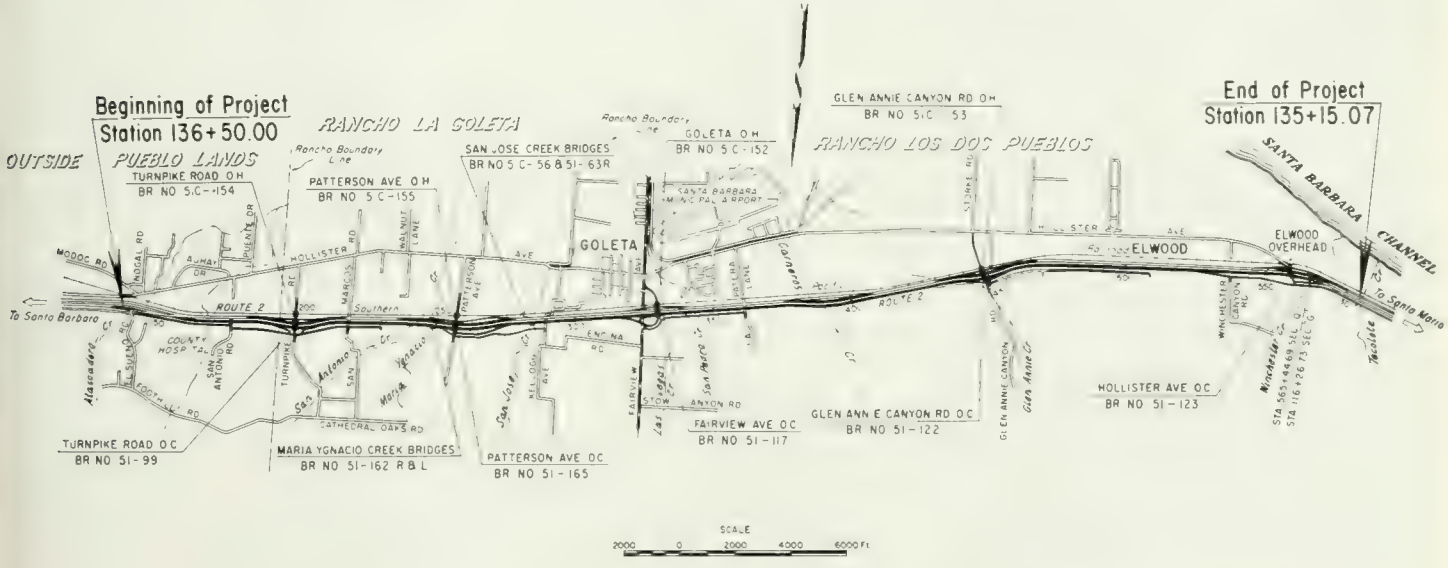
The existing US 101 highway was constructed in 1947 and consisted of an 11-foot and 12-foot traffic lane with 8-foot shoulders. The structural section consisted of three inches of asphalt concrete over six inches of crusher-run base on 9-15 inches of imported borrow. Considerable alligator cracking had developed on the traveled way and maintenance of the highway had become extremely costly.

Roadway Salvaged

In the early design stage, consideration had been given to salvaging the existing roadway by overlaying it with an asphalt concrete blanket.



This westward view toward the ocean shows the Glen Annie overcrossing at the center of the photo. The left or eastbound lane was not completed when this photo was taken.



Limits of the project, as indicated in the above map, is between El Sueno Road 2.4 miles west of Santa Barbara and 0.5 of a mile northwest of Elwood overhead on U.S. 101 in Santa Barbara County.

However, the maintenance problem soon indicated that more extensive rehabilitation would be required. It was then decided to pulverize the existing asphalt concrete and cement treat the top eight inches of existing roadway using the pulverized asphalt concrete as part of the material to be cement treated.

Pulverizing the existing asphalt concrete was done during construction by ripping it, then breaking it up with a sheepsfoot roller and, finally, by thoroughly granulating it with a mechanized pulverizer. In most cases, three passes of the pulverizer satisfactorily prepared the old asphalt concrete for cement treatment.



The Turnpike Road overcrossing passes over the freeway at the center of the photo with the San Marcos High School to the left of the overcrossing and the Cathedral Oaks Elementary School to the right. Group of buildings in the right foreground is the Santa Barbara County Hospital.

The pulverized asphalt concrete and sufficient underlying base material to make the required eight-inch depth of treated base was then formed into sized windrows and mixed cement and water using a self-propelled road mixer.

The resulting mixture provided an exceptionally high quality base which is expected to give an unusually long service life at approximately one-third the cost of construction with imported aggregate for cement treatment.

Structural elements of the new westbound lanes consisted of 0.67 feet of portland cement concrete pavement over 0.33 feet cement treated base Class B; 0.17 of aggregate base Class 3 all over 0.83 of Class 2 aggregate subbase material. The 0.17-foot-deep layer of aggregate base was provided as a working table for roadmixing the cement treated base because of the expected use of cohesionless sand as subbase.

Base is Extended

The contractor elected the optional slip-form method of placing portland cement concrete pavement. Accordingly, the cement-treated base was extended in width by 12 inches or more at each side during construction to provide greater support and protection at the pavement edges.

The slip-form paver selected by the contractor is a machine mounted on four independent tracks and assemblies grade control is taken from the subgrade in the track paths. Thus the smooth riding quality of the finished pavement is dependent on the accuracy and uniformity of the subgrade, particularly at the track paths. This factor requires an extra effort in making grade on the cement treated base.

In order to insure that the minimum of 0.67 feet specified thickness of concrete was obtained throughout, cross sections of the completed cement treated base were taken to determine the relationship of the pavement subgrade to the track path grade. These cross sections were then used to determine a screed setting for the slip-form machine to insure a minimum pavement thickness obtained at the thinnest point. A scratch template, which also traveled on the track grade, was then set to the same setting and subgrade was further checked to avoid any undetected high spots.

This was only the second time that this make or model of slip-form paver had ever been used on highway construction. At the start of paving, the profile index obtained exceeded the specified maximum. The contractor then made several changes in the equipment and added a special job-built spreader box to uniformly control the amount of concrete placed ahead of the paver by the mixer operators. This spreader box was the chief factor in achieving the proper profile index during the remainder of the paving. This contractor also had some difficulty in forming the longitudinal keyway which provides the shear key for additional lanes when constructed at a later date. However, the use of heavier tie wire and the addition of more guides on the slip-form paver largely eliminated this difficulty. Other than the slip-form paver, the contractor used conventional methods for construction of the freeway.



The freeway under construction. A mixer prepares cement-treated base as described in the article.

Aggregate Shortage

Highway construction in this area is complicated by the shortage of suitable mineral aggregate for the various bases. This is true in spite of the proximity of the Santa Ynez Mountains with numerous rock outcroppings. However, tests indicated this rock was too soft to use as aggregate materials for the project.

After much searching, the contractor obtained a source of aggregate subbase near the west end of the project. The subbase was obtained from a sandy cut which was part of the grading plan of a subdivision to be constructed near the freeway location. For aggregate base and mineral aggregate for cement treated base, the contractor elected to blend sandy material from a local source with crushed aggregate hauled from the Santa Clara River near Ventura. The blending was accomplished on the belt loader at the local material site.

Mineral aggregate for asphaltic concrete and Portland cement pavement were obtained from commercial sources in the Santa Clara River, and involved a 30-mile haul to the project. As an example of the extreme scarcity of suitable materials in this area, Portland cement concrete aggregate for highway construction is produced by the heavy media process. The asphaltic concrete plant and the Portland cement concrete batch plant were owned by the Contractor and set up directly on the job site.

Traffic Accommodated

The general plan of construction for this project was to leave traffic on the existing lanes, construct necessary short sections of the new southbound lanes at each interchange and complete all grading and paving for the new northbound lanes. Then after the northbound lanes were completed, traffic was shifted and the existing roadbed reconstructed.

Five interchanges were constructed as a part of the project with provision made for construction of a sixth at Carneros Creek when necessary to



The Glen Annie Creek channel change. The channel is flared (extreme left) to catch the maximum water flow and is concrete lined where water erosion will be greatest. Note the middle section on the left where only grass planting is needed for sufficient erosion control. The view is south with portions of Goleta visible in the right background.

serve the anticipated growth in this area. All interchanges were of the overcrossing type combined with a railroad overhead. On and off ramps on the south side were located between the freeway and the railroad without complication. The overcrossing structures are all four span with total lengths ranging from 196′ to 241′. Precast, prestressed girders now in extensive use on freeways throughout the State were used in the two center spans over the freeway lanes. The end spans are cast-in-place "T" beam construction. The railroad overheads all have three spans with the center spans over the railroad of precast, prestressed girder construction. The length of the overheads varies from 163′ to 168′. Other bridge structures of importance include parallel bridges over Maria Ignacio Creek, east of Patterson Avenue and twin bridges over San Jose Creek west of Patterson Avenue.

Drainage Channels

Drainage channels of considerable magnitude were also included as part of this freeway project. Channel changes were built at San Antonio Creek and Glen Annie Creek with appurtenant channels controlling Maria Ignacio Creek and San Jose Creek. In construction of these channel changes, approximately 2,000 cubic yards of Class B Portland cement concrete slope paving was placed. At Las Vegas Creek an existing double 12′ x 5′ reinforced concrete box was extended, right and left, a total of 208′. At Caneros Creek, where provision has been made for a future interchange, a box culvert was extended 253′ with a special 18′ x 7′ reinforced concrete box. These considerable channel change structures were essential because native soil in this area is mostly a sandy silt and is easily eroded. In addition to the concrete slope paving, all remaining slopes were treated with straw, hardy grass seeds, and fertilizer to prevent erosion. Nearly all open drainage ditches were lined with air-blown mortar.

This work, along with installation of lighting and signs, completed the freeway project as previously planned; however, provisions have been made through location of the alignment, acquisition of right-of-way, and by methods of construction to provide for construction of an additional two lanes when future traffic volumes require, and when funds become available.

Future Construction Plans

Supplemental contracts will, no doubt, be let at a later date when the Clarence Ward Memorial freeway is completed, as directional signs will be needed on US 101. Also, when the funds become available and, in keeping with Division of Highways policy, it is anticipated that considerable landscaping for functional benefit and general beautification of the area will be provided as has been done with other freeway sections in the southern Santa Barbara County area.

This project got underway April 4, 1960, and was completed May 4, 1962, at a cost of approximately $3,910,000. The contractor was Silva and Hill and Jack L. Adams, acting as a joint venture. The Resident Engineer was G. G. Puder. The Bridge Representative was Walt Bedell. The entire operation was under the supervision of E. R. Foley, District Engineer.

Tunnel Lights

New Fluorescent Lamp Fixtures Are Brighter, Vandal-Resistant

By T. N. KREIBERG, Senior Highway Electrical Engineer

ONE OF THE major objections to the installation of pedestrian tunnels under elevated embankment sections of freeways has been the problem of illumination. At best, in daytime the tunnel presents the aspects of a long dark hole that is uninviting to enter. For many years the only fixtures available for the illumination of these structures were small incandescent fixtures embedded in the concrete of the structure.

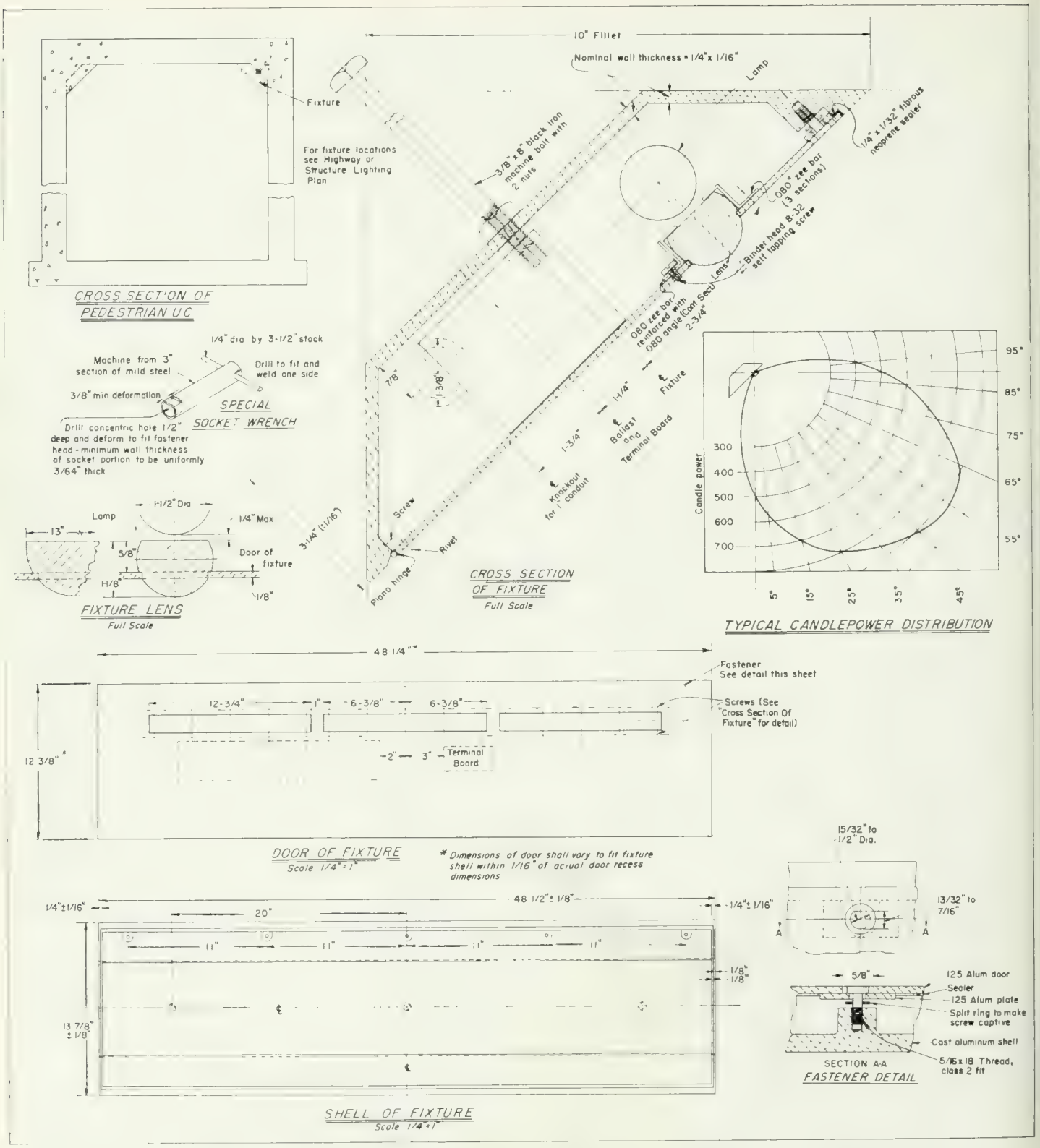
These fixtures are grossly inadequate from the standpoints of light output and susceptibility to damage from vandalism. The unit consists of a fixture shell embedded in the roof of the pedestrian tunnel which contains a 150-watt incandescent lamp with an acrylic plastic lens and covered by a heavy metal guard. The guard is added in an attempt to minimize vandalism from objects being thrust into the fixture.

Heat Limits Size

This protection is not only inadequate, it also greatly reduces the light output from the fixture. Furthermore, the size of the incandescent lamp that can be used in this fixture is limited by the heat produced which can be dissipated from the fixture. Otherwise the lamp temperature will rise sufficiently to shorten the life of the lamp and cause premature burnout. The necessity for embedding the fixtures



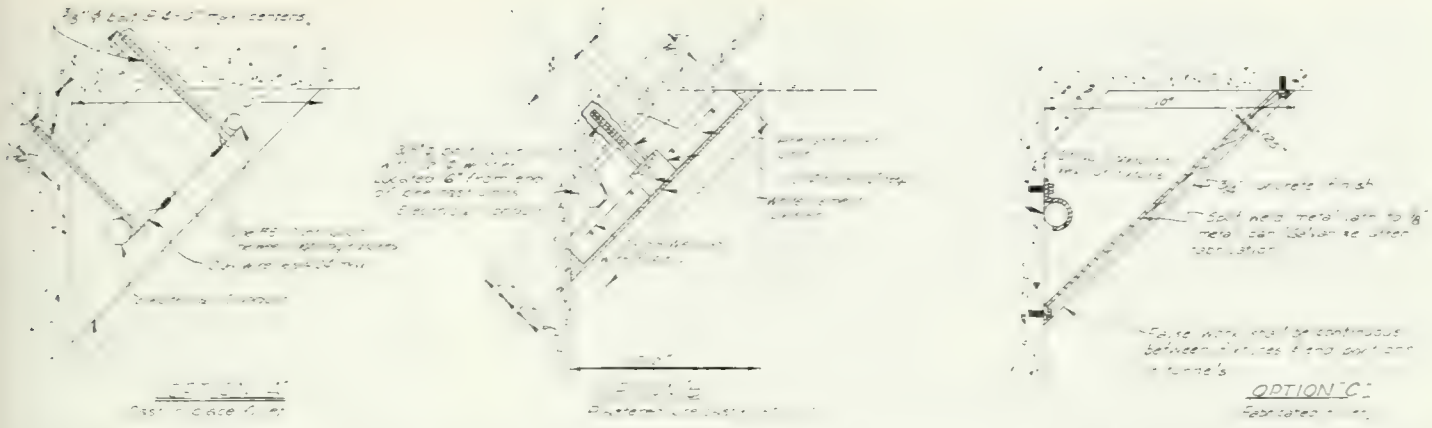
A night view inside the East Third Street Pedestrian Undercrossing in the City of Benicia following installation of the new fluorescent lights.



A diagram showing some of the detail of the new fluorescent light fixtures being installed in pedestrian undercrossings.

in the concrete of the tunnel to protect them from acts of vandalism further decreases the ability of the fixture to dissipate the heat from the lamp. The resulting illumination in the tunnels consists of a few dim patches of light in an otherwise long, dark area and constitutes a policing problem to the local agencies.

The ideal type of lighting for these structures would be that provided by fluorescent fixtures. A fluorescent fixture would provide 52 lumens of light for every watt of electrical power used as compared to about 18 lumens



The Division of Highways has developed several means of surface-mounting the new fixtures and providing 10-inch gunited cast-in-place or prefabricated fillet units to fill the corners between the fixtures.

per watt produced by an incandescent fixture. Thus, a fluorescent lamp is not only about three times as efficient in producing light as an incandescent lamp; its life is also several times longer. A fluorescent light fixture will also produce a long-line source of light that is more appropriate in a tunnel.

Complications Listed

The development of a fluorescent fixture for pedestrian tunnels has been complicated by the following considerations:

1. Resistance to vandalism,
2. Adequate light provision and distribution,
3. Adequate provision for heat dissipation,
4. Accessibility for relamping and other maintenance,
5. Ease of installation during the construction of the tunnel and simplicity of wiring afterwards.

The advent of a fluorescent lamp with a half-inch wide slit in the phosphor coating along the full length of the glass tube has simplified the design of an appropriate fixture. The lamp is known as a 30-degree aperture, very high output fluorescent lamp. The aperture and the special phosphors applied to the lamp provide an extremely bright, and what is essentially a half-inch wide, source nearly four feet long.

The fixture that was designed around this lamp consists of two main parts: A fixture shell embedded in the tunnel concrete and a fixture door. All of the electrical components for the fixtures are mounted on the door, which consists of an $\frac{1}{8}$-inch thick panel of plate aluminum of size necessary to fit the door opening in the fixture shell. The use of a cast aluminum door would be undesirable since such large thin castings would be brittle and subject to cracking from vandalism attacks. The ballast is mounted on the door in order to provide adequate radiation to dissipate the heat generated by it.

Lenses Mounted in Door

The door also contains three slots in which the fixture lenses are mounted. The lenses consist of inch-and-a-half sections of clear methyl-methacylate plastic resin rods which have been beveled on the ends and a flat surface provided along the length of the rod. These are mounted in the door with zee bars in such a manner as to place the side of the lenses parallel to the door surface. The lamp is then mounted approximately one-fourth inch behind this flat surface of the lens.

The sockets are a special bi-pin type designed for the lamp and are



A close-up of one of the new fluorescent fixtures in the East Third Street Pedestrian Undercrossing in Benicia (see previous page).

rotatable so that the aperture can be positioned directly behind the lenses. The sockets are rated at 1,000 volts and are approved by the Underwriters Laboratory for outdoor use. An unusual feature of these sockets is the neoprene "O" ring which bears against the end of the tubes to exclude moisture. Fluorescent lamps immersed in water have been successfully illuminated while using these sockets. The attachment of the lamp, lenses, ballast and terminal block to the fixture door, which is provided with a full piano hinge and four specially designed vandal resistant fasteners, provides an easy means of attaching the unit to the shell.

The fixture shell is an aluminum casting about 14 inches wide, somewhat over four feet long and about four inches deep. The fixture shell is designed to be embedded in the corner fillet of the pedestrian tunnel. The Division of Highways Bridge Department has modified standard drawings for pedestrian tunnels to provide a 10-inch fillet into which the fixture casting can be embedded. This design contemplates that the contractor will construct the inside form of the pedestrian tunnel with a constant cross section having the 10-inch fillet throughout. The fixture shell and the conduit can then be quite simply mounted on the 45 degree slope of the fillet prior to the placing of concrete. After the contractor has stripped the inside forms of the tunnel and pulled the electrical conductors, he mounts the fixture door on the embedded fixture shell and connects the conductors to the terminal blocks. The insertion of the lamps and their positioning concludes the necessary electrical work in the tunnel.



BEFORE—A night photo of lighting inside the Miner Avenue Pedestrian Undercrossing in Stockton prior to the experimental installation of the fluorescent fixtures.

Socket Wrenches Provided

The vandal-resistant fasteners are provided with special socket wrenches and are in conformity with the requirements of the Los Angeles Bureau of Street Lighting which has the responsibility of maintaining a majority of the pedestrian tunnels in the State.

The first installation utilizing these fixtures was in the East Third Street Pedestrian Undercrossing in the City of Benicia (see photograph). The unlighted fixtures have been in this tunnel for a period of approximately nine months. During this time, evidence indicates that they have been subjected to hammering from large rocks and numerous heavy objects thrown at them. The testing of these fixtures by vandalism has been evidenced by the numerous nicks on the doors and the presence of rocks in the tunnel. These tests indicated that the doors were too susceptible to flexure and as a result, it has been necessary to provide additional reinforcing to stiffen the doors and prevent the bending which has broken several lamps.

A fluorescent fixture manufacturer in Stockton has been most co-operative in assisting in the development of this fixture.

Model Is Tested

The company constructed and helped test a preliminary model of the fixture. After the preliminary unit was tested and modified, five experimental fixtures were purchased from this company. These fixtures were mounted on temporary pipe supports and placed in the Miner Avenue Pedestrian Undercrossing in Stockton for evaluation. The accompanying

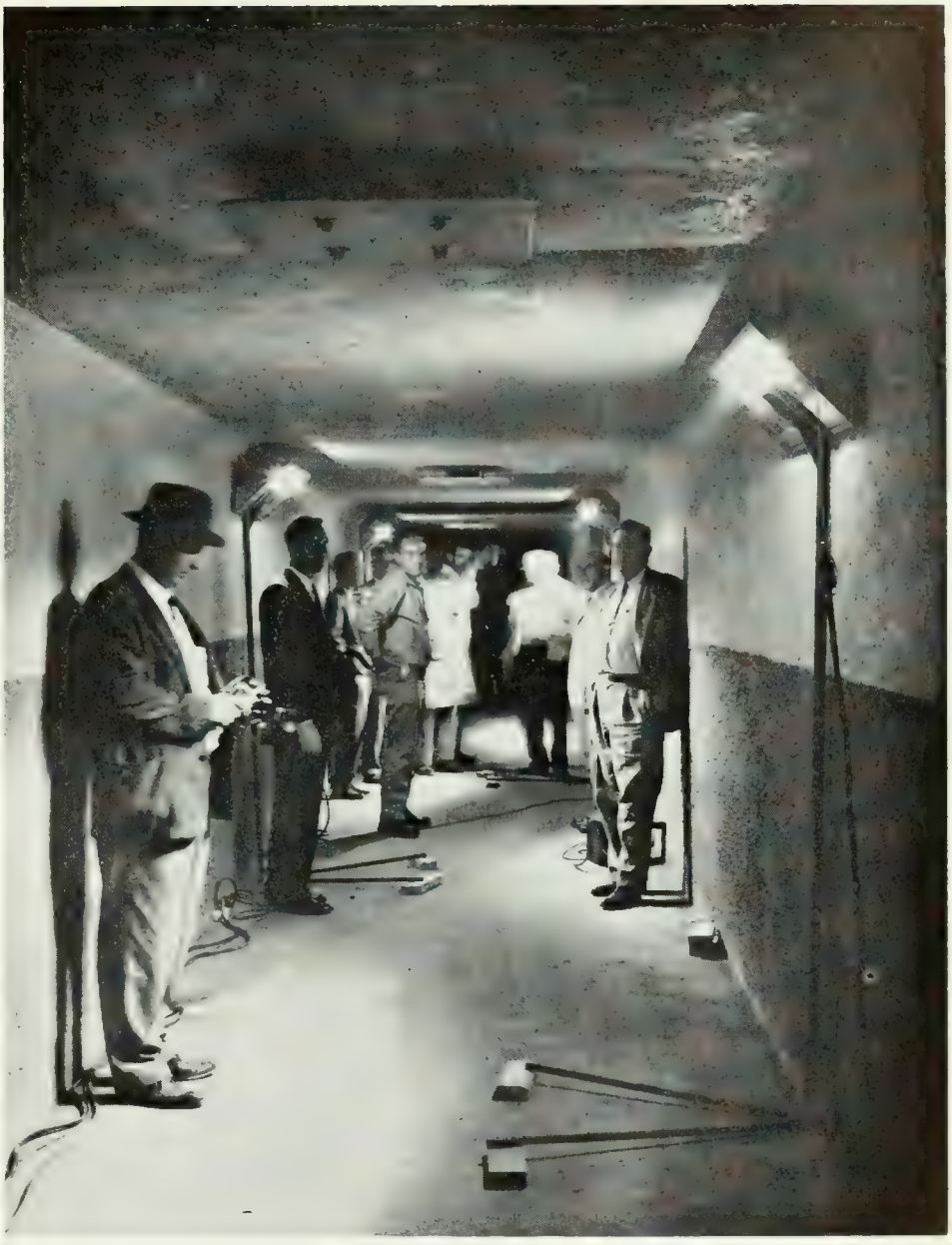
photographs, which were taken by a camera using identical film and exposure, graphically indicate the contrast in lighting obtained from the new fixtures compared to those fixtures presently installed in the structure. The seriousness of the vandalism problem is attested by the heavy steel plates which can be seen covering the incandescent fixtures in the ceilings of the structure.

It was concluded from this test that the fluorescent fixtures would provide an acceptable level of illumination when staggered on both sides of the tunnel at a spacing between fixtures of approximately 20 feet. At the time of this writing, the cost of these fixtures is in the neighborhood of $175. It is expected that increased use and competition will serve to reduce this cost.

No Louvers Necessary

The original design of the fixture included a number of louvered openings in the doors to provide some convection movement of air since it was feared that the ambient temperature inside the fixture due to heat from the ballast and the lamp would become unreasonably high. As a result of tests by the manufacturer, it appears that the fixture will operate satisfactorily without these louvers. Experience with other equipment having similar openings has included having vandals filling the openings with paper and lighting the paper. Because of this, louvers were omitted from the final design. With minor modifications, the unit has been found acceptable by the Los Angeles Bureau of Street Lighting.

The design of this fixture was influenced by the possibility that it would be used for relighting existing pedestrian structures in the event that it was successful. Consequently, the back of the fixture was designed to clear the five-inch fillets which had been standard on previous pedestrian tunnels. The Bridge Department has developed several acceptable means of surface-mounting the fixtures and providing 10-inch gunited cast-in-place or prefabricated fillet units to fill the corners between the fixtures. The first such installation of relighting a pedestrian tunnel is in the Jackson Street Pedestrian Undercrossing under the San Bernardino Freeway, about one-quarter mile easterly of the east city limits of Monterey Park.



AFTER—A night photo of the interior of the Minor Avenue Pedestrian Undercrossing in Stockton following experimental instaliation of the fluorescent fixtures.

The development of this fixture was financed in part out of the State annual apportionment of Federal-Aid highway funds for research, with the approval of the Bureau of Public Roads.

CITIES GET $34,948,755 STREET APPORTIONMENT

A record total of $34,948,755 in state gasoline tax revenues has been apportioned to the 377 incorporated cities in California for city street work during the past fiscal year, the State Division of Highways has announced.

This is $1,136,290 more than last year's record $33,812,485.

This amount is the revenue from the five-eighths of a cent per gallon out of the state gasoline taxes paid by highway users.

Yolo Causeway

New Crossing Is Scheduled For Early 1963 Completion

By R. F. COLLEY, Resident Engineer and M. CHAPMAN, District Representative



AFTER 46 years of service the existing Yolo Causeway is being replaced by a new crossing which is at present more than two-thirds complete. Elimination of this narrow old structure will be a great improvement in the highway system between Sacramento and Davis which is a part of US 40, US 99W and Interstate 80. This new crossing of the Yolo Bypass (a strip of lowland that is flooded when relief from high water on the Sacramento River is needed) is the major objective of a $6.9 million contract for realignment of 5.7 miles of



The new eastbound Yolo Causeway structure at its east end. The old causeway is in the background.

"GREAT YOLO BASIN CONCRETE TRESTLE" WAS COMPLETED IN MARCH, 1916

(Condensed from articles in the July 1914, July 1916 and December 1932 issues of *California Highways and Public Works*).

The Yolo Causeway across the bypass of the Sacramento River west of Sacramento was a feature of special importance in the early planning of the State Highway System, one of the objectives of which was the shortening of routes between sections of the State.

South of the bridge at Meridian, Sutter County, there was no way, during flood periods, for vehicles to cross the lowlands that extended from some 15 miles north of Marysville to Rio Vista, a distance of 120 miles. Thus the east and west sides of the Sacramento Valley had no highway communication at flood times, which lasted from six to eight months annually, and highway travelers to San Francisco and the Bay area had to go by way of Stockton and Altamont.

For a few months during summer and fall, when the flood waters of the Sacramento River had subsided and the marsh lands had dried out, a precariously passable road, known as the "Tule Jake" Road, was the only means of crossing the basin.

The route of the "Great Yolo Basin Concrete Trestle," crossing the lowlands between Sacramento and Davis, was laid out as a state highway April 22, 1914. Bids for construction were received June 8, 1914. The length, 3.1 miles—a wooden trestle for about 0.4 mile and reinforced concrete trestle with a draw span for about 2.7 miles. It provided a clear driveway of 21 feet in width. The contract was let July 21, and driving piles on the west end began November 1, 1914.

The causeway was opened to traffic on March 18, 1916, having been under construction for a period of about a year and a half, and costing about $400,000. Over 2,000 automobiles used the trestle on the day following its opening.

It was formally opened and dedicated with a gala four-day celebration May 11 to 14, 1916, with practically the entire Sacramento Valley participating.

As an emergency unemployment relief measure, funds for widening the causeway were advanced from federal aid allotments in the fall of 1932.

For weeks hundreds of men in the mills and woods of the Redwood Empire were employed in getting out redwood piling and timbers for an additional 20-foot width on the three-mile trestle.

While the labor required at the bridge site and the direct labor benefit in the adjacent territory was relatively small, the project provided a tremendous stimulus to the timber industry in the northern counties in providing the six million feet of structural lumber to be used on the causeway. Thousands of workers in the mills, the woods and on the logging railroads were employed in producing this order, thus spreading unemployment relief to the entire redwood belt.

highway, beginning at Swingle at the west terminus and joining the existing four-lane divided highway at about one-half mile east of the Yolo Bypass.

The new alignment will be to the south of the existing highway, and will consist of a six-lane divided highway with provisions for widening to eight lanes. Besides the crossing of the bypass the contract includes: an undercrossing structure adjacent to the west levee of the bypass, the widening of the existing Yolo Causeway Undercrossing to six lanes at the east end of the project, 2.6 miles of six-lane divided highway, ramps, connections, frontage roads and appurtenances. The contract was awarded to a joint venture of Fredrickson and Watson Construction Co. and Lew Jones Construction Company.

Part Is Earth Fill

An earth fill makes up about 4,700 feet of highway inside the Yolo Bypass, with the remainder of the 3.1 miles of bypass divided into two pairs of parallel structures. The length of the west structures will be 2,880 feet and that of the east structures will be 8,800 feet. Eastbound and westbound traffic will be carried on structures completely independent of each other. Each structure will have a curb-to-curb width of 46 feet, consisting of three 12-foot traffic lanes with an eight-foot shoulder on the right and a two-foot shoulder on the left.

When the north half of the existing causeway was completed in 1916 the width between wheelguards was only 21 feet. The substructure consisted of about 2,500 feet of timber-pile trestle and 14,000 feet of concrete-pile trestle with an 80-foot bascule span at the east end. In 1933 the causeway was widened to its present width of 42 feet by adding a timber-pile trestle on the south side, and the east end was revamped to a 104-foot double-leaf bascule.

The new causeway structures will provide two roadway widths of 46 feet each as compared to a single



Looking west between the new twin parallel structures. A portion of the old structure can be seen in the distance far right.



Looking west over the Yolo Causeway project. The 4,700-foot-long fill and pavement is completed. The two 2,800-foot-long structures at the west end are nearly complete. The eastbound lanes of the two 8,800-foot-long structures (broken white line left center) will be completed late this summer and traffic will be detoured over it while the westbound structure is being completed.

width of 42 feet which now exists. The entire existing causeway structure will be removed under this contract.

Bidding Alternatives

To intensify competitive bidding five acceptable superstructure alternatives for the Yolo Causeway were designed from which the contractor could choose. The alternatives were: (1) precast pretensioned double channel deck units with an asphalt concrete wearing surface; (2) precast pretensioned "I" girders with a cast in place concrete deck; (3) precast pretensioned "T" girders with a cast in place deck; (4) precast rectangular reinforced concrete girders with a cast in place concrete deck; (5) a conventional cast in place reinforced concrete "T" beam. All alternatives to be supported on concrete pile bents spaced at 40-foot centers. The pile bents to consist of six concrete piles and a reinforced concrete cap.

From the five alternatives the contractor chose alternative (1) and used cast in drilled hole piles for support. For fabrication of the prestressed double channel deck units, the contractor constructed a casting yard at the jobsite. The casting yard consists of four casting beds each approximately 500 feet long with 12 steel deck unit forms for each casting bed. The contractor is able to cast 24 deck units every day. The pretensioning force of 379,000 pounds required for the deck units is obtained by stressing 24 high-strength 7/16-inch steel strands which are anchored at each end of the casting bed. This force is held by bed anchorage until the concrete reaches the required design strength of 4,000 psi, at which time the force is transferred from the anchors to the concrete. To attain this design strength, a steam cure is applied at 140 degree Fahrenheit for 12-14 hours.

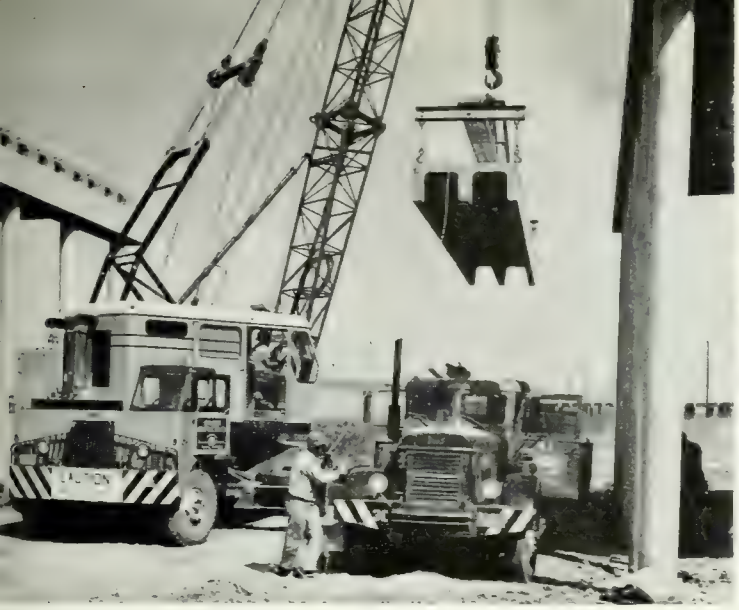
5,256 Deck Units

Each deck unit is 39 feet 4 inches long, 5 feet 8 inches wide, 2 feet deep, and weighs about 15 tons. A total of 5,256 of these deck units will be required for this project. There is enough prestressing strand in these units to reach from Mexico to Oregon.

Grading consisted of about 100,000 cubic yards of roadway excavation and nearly 1,050,000 cubic yards of imported borrow. Approximately 757,000 cubic yards of the borrow was placed as embankment for the 4,700-foot earth fill section inside the bypass.

The two state-owned material sites for borrow were located within the bypass north of and parallel to the new alignment and lying on either side of the existing causeway.

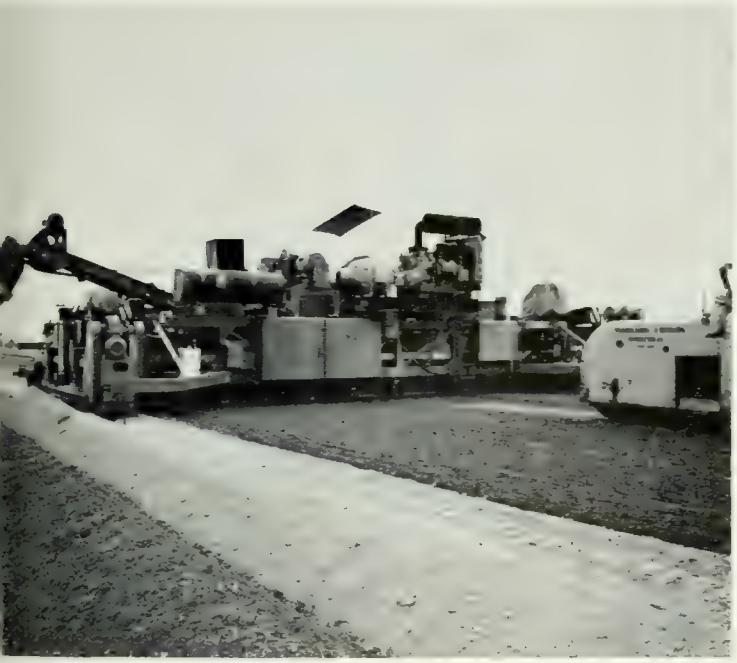
For the embankment inside the bypass, loading and hauling equipment consisted of a tractor with bulldozer attachment which was kept continually busy pushing the 24-cubic-yard scrapers used to haul the material. Compaction equipment consisted of a tractor with bulldozer and heavy-



Erecting the deck units on the west Yolo Causeway.



Pretensioning deck unit strands. An inspector is checking elongation.



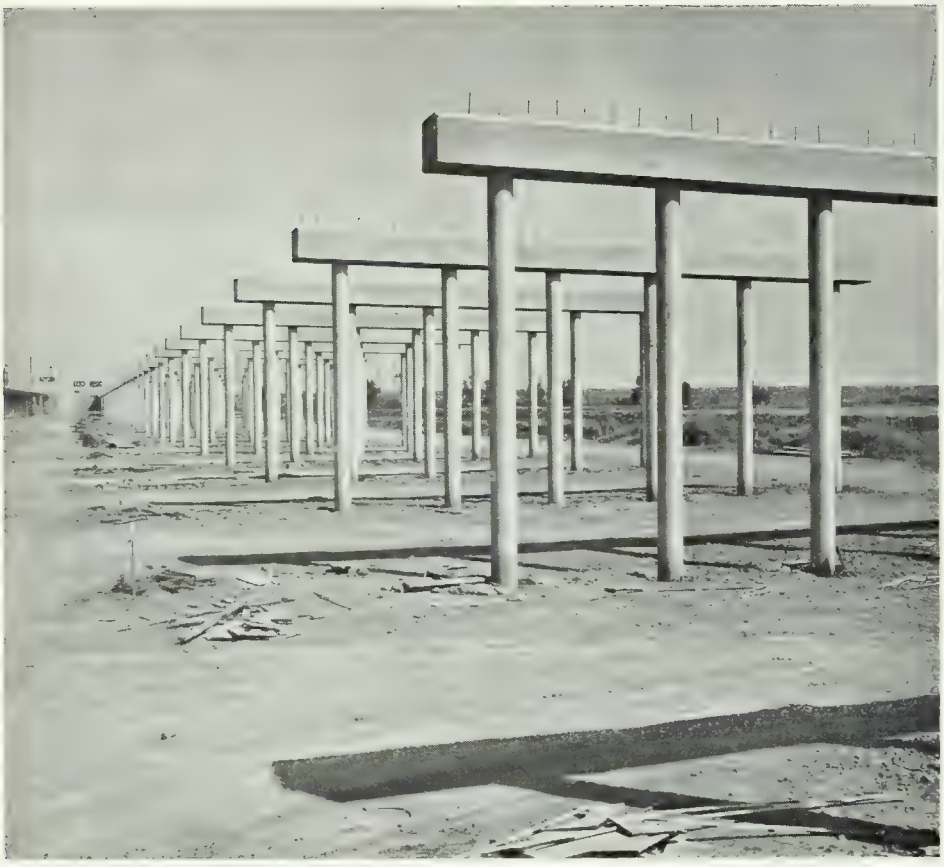
ABOVE—Rear view of the "Road Builder" trimming cement treated base.
BELOW—Steel deck unit forms being prepared for concrete pour.



ABOVE—Front view of the "Road Builder" trimming cement treated base.
BELOW—Rear view of the slipform paver in operation.







The substructure of the Yolo Causeway ready for deck units.



Constructing choker on the embankment inside the Yolo Bypass.

duty disc, a large motor grader with disc, and a tractor with bulldozer and sheepsfoot attachments. To maintain an average daily production, the haul distance could be varied from 200 to 5,000 feet.

Cohesionless Sand

The portland cement concrete pavement is supported by aggregate base over aggregate subbase. The subbase is a cohesionless sand previously dredged from the Sacramento River and stored in a state-owned site by the U.S. Corps of Engineers. It was placed and watered in full thickness in lieu of layers, because of lost traction to hauling equipment. Four to five passes of a vibratory compactor obtained the required 95 percent compaction. Grade was made with a motor grader.

Aggregate base, obtained from a commercial source, was hauled to the job in bottom-dump trucks and spread on stable base in windrows. It was then picked up with a self-loading scraper and spread on one side of the subbase to form a stable base for further windrowing. This base material was then bladed laterally across the subbase and compacted. Grade was left between 0.03-foot and 0.05-foot high. Final trimming was made by the new Guntert and Zimmerman "Road Builder" in a single pass, allowing for the one-inch difference in pavement thickness between the inside and middle lanes. This new "Road Builder" is built on the same principle as the same firm's slipform paver and was used for the first time on this project. It is guided electronically by taut, horizontal wires set with reference to line and grade. The machine weighs about 80 tons and is driven by electric motors which are supplied by a 20-kilowatt diesel-powered generator.

Self-Propelled Device

The huge device is self-propelled on two sets of tracks, each driven by individual electric motors. Reversible augers across the front, also powered by electric motors, distribute the material laterally in front of the machine. Following these is a row of vibrating compactors, each two feet wide and operated by a battery of electric mo-



A view of the contractor's yard for casting deck units. The boiler for furnishing steam to cure the deck units is housed in the building (center). On each side of the boiler house are casting beds, each with 12 steel forms in which the units are cast. Paralleling the casting beds are storage areas for completed units. At the far edge of the yard is the circular storage track for steam hoods which are used to enclose deck units during the steam curing period. This yard can produce 24 units a day.

ors. Behind the compaction units is nother set of augers which trims the aterial to grade and brings the excess o the center of the machine where it scooped onto a conveyor and disosed of along the edge of the subrade, to be used in the shoulders. A rikeoff plate on the rear trims off ny minor high spots.

The top four inches of the aggreate base was cement treated to Class requirements for the middle and utside lanes, and to Class B requirements for inside lanes. Cement was dded in proper proportions to the ree windrows, two being 13 feet ide and one 12 feet. A road mixer was used to partly spread the material, and initial compaction was made by a 12-ton, three wheel roller.

The "Road Builder" trimmed and compacted the CTB to grade. Finish rolling was done with a pneumatic-tired roller. Minor adjustments up to 0.03-foot were made in the grade line to insure minimum design pavement thickness.

Paver Used for Surfacing

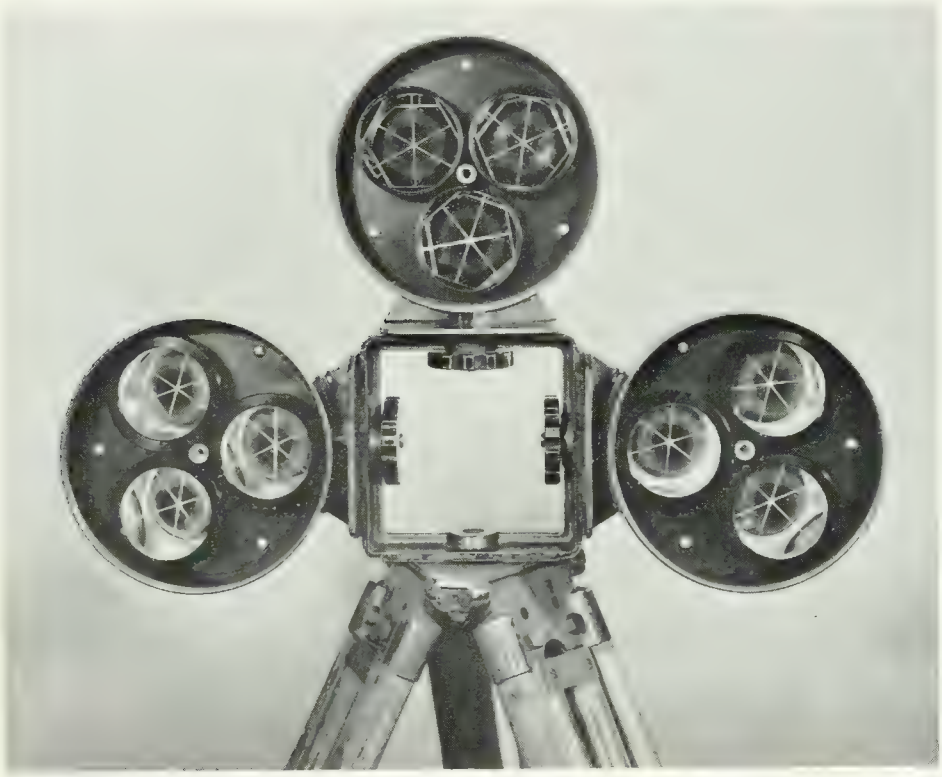
A slipform paver was used for concrete surfacing. A total of 0.035-foot average excessive thickness resulted from the paving operation. Stabbed subgrade accounted for 0.018-foot and the remainder is assumed to be in the high finished grade and waste.

Smoothness of the pavement was affected primarily by the number and duration of paver stops. A high, constant production contributed to a smooth finished pavement.

Since a portion of the existing Causeway must be removed before the westbound structure can be completed, all traffic will be detoured over the eastbound roadway and structures in the late summer of 1962. The existing Causeway will then be removed and the westbound lanes can be completed. The project is scheduled for completion in the spring of 1963.

Meet the Geodimeter

By GEORGE P. KATIBAH, Supervising Photogrammetrist, and
DAN RADMANOVICH, Geodimeter Party Chief



Nine prism reflecting unit obtained by combining 3 three-prism units on special tripod bracket.

In the fall of 1957 the Headquarters Photogrammetry Section acquired a Model 3 Geodimeter, an instrument of Swedish manufacture, for the purpose of measuring basic control survey distances. The range and accuracy of the Model 3 made it possible to make direct survey ties to U.S. Coast and Geodetic Survey triangulation stations by traverse procedures. In this manner the California Coordinate System could be established in the immediate vicinity of a highway mapping project without resorting to costly and time consuming conventional survey methods. This approach was particularly practical in those portions of the State which presented difficult survey problems because of the remoteness of the triangulation stations or the ruggedness of the terrain.

Value Established

The Geodimeter has demonstrated its reliability and value in the complement of precise surveying equipment. Since the advent of the Model 3, a Model 4 instrument was introduced which has proven to be of even greater value for many types of highway survey problems. The latter intrument is now part of the survey equipment in 7 of the 11 district offices as well as in the Headquarters Office.

It is the intent of this article to acquaint the reader with the Geodimeter. This and other electronic distance measuring instruments have indeed precipitated a technological revolution which promises to completely alter the concept of precise surveying procedures and their application to the more routine surveying problems.

Geodimeter System

The rapid development of electronic technology since World War II has provided an extremely flexible series of instrumentation components applicable in all phases of science and industry.

The combination of electronics and accurate timing devices such as the crystal clock has enabled scientists to make a more precise determination of the velocity of light and investigate the effect of meteorological conditions upon its propagation. These studies led to the use of light velocity determinations as a basis for distance measurement.

One of the results of these experiments was the design of the Geodimeter, which is an electro-optical instrument that measures distances with rapidity and accuracy. Observations are normally made during the night hours.

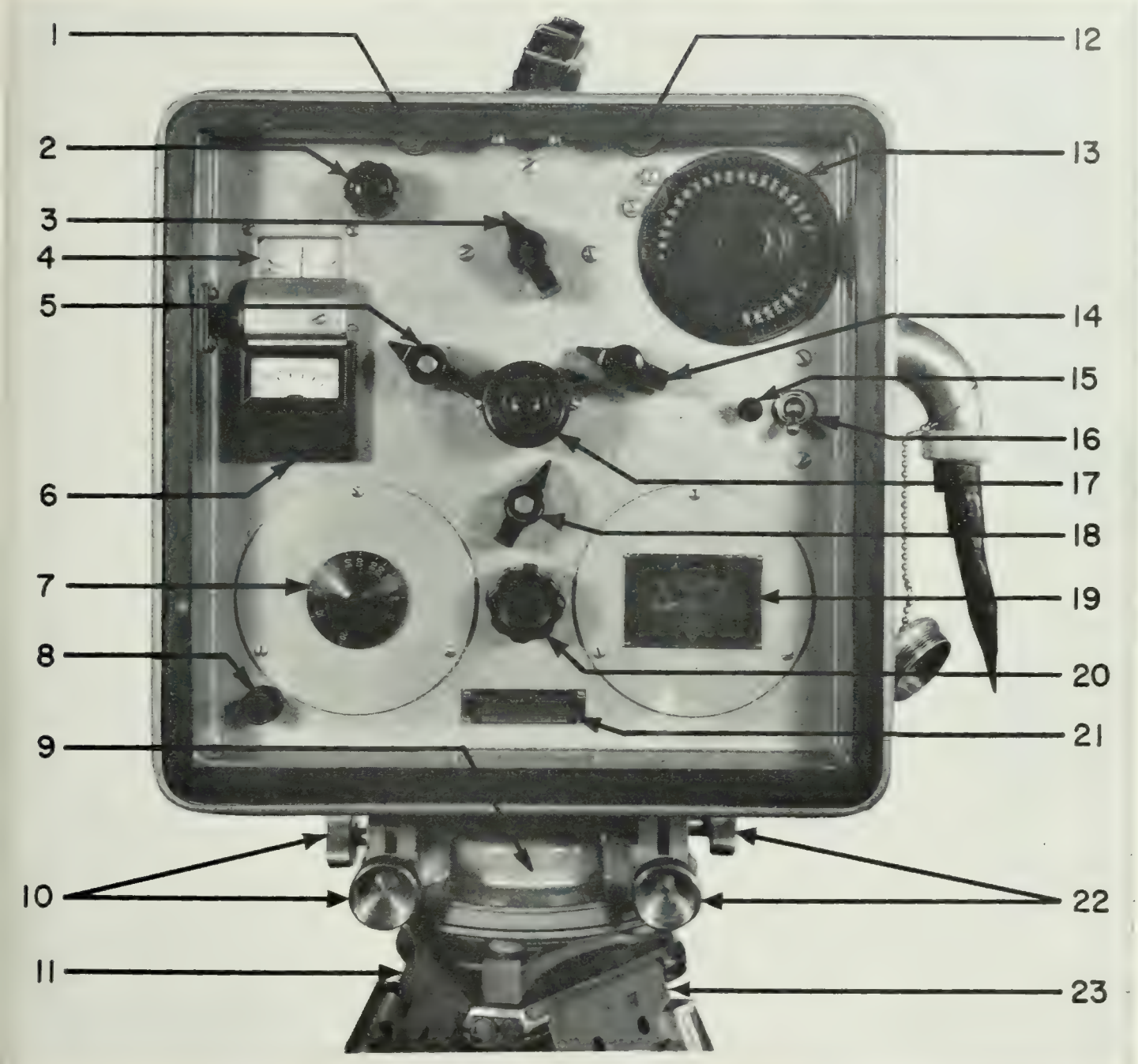
The Geodimeter was invented by the noted Swedish geodesist and physicist Dr. Erik Bergstrand. At the present time, three models are available, of which the Model 4 is the one best applicable to highway surveys.

Operating Principles

The basic principle of all models of the Geodimeter system of distance measurement is the indirect determination of the time required for a pulsed light beam to travel between two stations.

A modulated beam of light is emitted from the Geodimeter to a passive reflector placed at the other end of the line being measured. The reflector returns the light pulses back to the instrument where a phase comparison is made between the projected and reflected light pulses.

The design theory of the various models is essentially the same; how-



Geodimeter Unit, panel view

1. *Panel light and crystal oven signal*
2. *Zero adjustment control*
3. *Frequency selector*
4. *Null indicator instrument*
5. *Control instrument switch*
6. *Control instrument*
7. *Focusing dial*
8. *Coarse sighting eyepiece*
9. *Geodimeter head*
10. *Horizontal tangent screws*
11. *Star plate*
12. *Panel light*
13. *Delay line dial with index*
14. *Phase selector*
15. *Light sensitivity control*
16. *Projection lamp switch*
17. *Fine sighting eyepiece*
18. *Fine sighting switch*
19. *Name plate*
20. *Focusing knob*
21. *Type and serial number plate*
22. *Vertical tangent screws*
23. *Wild T2 Tripod*



Typical operational set-up at night; Dan Radmanovich at the Geodimeter, Lee Winn measuring the vertical angle with theodolite.

ever, the size of the optics, the type of delay line, and the number and frequencies of the crystal oscillators differ in each model.

To illustrate the operation of the Geodimeter, the Model 4 is described as follows with reference to schematic diagram on page 53.

The randomly polarized light from the projection lamp (1) passes through a condensing lens (2) and a polaroid filter (3) to a focus point between the Kerr-cell electrodes (4). The light rays pass through the Kerr-cell to the second polaroid filter (5) which is oriented 90° to the first filter. Since the two polaroid filters are crossed no light can pass through the second polaroid.

The Kerr-cell consists of two parallel electrodes in a glass container. The electrodes are immersed in a fluid of highly purified nitrobenzene. When a high voltage is applied across the electrodes the nitrobenzene becomes doubly refractive and rotates the beam of light so that it can pass through the second filter to the optical transmitter (6). As soon as the voltage is discontinued no light will be transmitted. In effect, the Kerr-cell acts as an extremely rapid electronic shutter and has no moving parts.

Voltage Applied

The high voltage applied to the Kerr-cell is generated by a highly stable radio frequency (RF) oscillator and amplifier (7) as a pulse with a frequency of about 30 million cycles per second (30 Mc/s). The resultant emitted light will flash at the same frequency.

The pickup coil (8) in the Kerr-cell circuit retains a minute portion of the RF power to serve as a reference point of the time when a light pulse leaves the Kerr-cell. This small RF pulse passes through the delay line (9) and into the receiver circuit (13).

The emitted light is returned to the Geodimeter by a prismatic reflector and is collected by the optical receiver (10), transformed into a line image by an astigmatic condenser system (11) to a point on the cathode of the photo-multiplier cell (12). The light is then converted to electrical signals by the photo-multiplier cell and conducted to the receiver circuit (13).

The phase relationship between the transmitted and received pulses is determined by adjusting the delay line until a zero condition is read on the null meter (14). The adjustment of the delay line is controlled by a dial which is graduated into 300 parts corresponding to approximately 1 centimeter of distance per part. The delay line dial readings are used for the computation of the observed distance.

The cathode of the photo-multiplier cell is modulated by the same RF frequency as the Kerr-cell, and therefore the sensitivity of the receiver varies in synchronization with the transmitted light.

Receiver Sensitivity

A reflector can be placed at a point where the maximum sensitivity of the receiver coincides with maximum light received by the photo-multiplier cell. At this point the photo-currents will be of equal amplitude, the null meter will read zero, and the delay line dial will also be at its zero point. If the reflector is then moved a few feet farther away, the synchronization will be lost and the null meter will read off zero. If, however, the reflector is moved further, another zero point will be found. The distance between zero points is called a "unit length," and corresponds to a change in reflector distance movement equal to a time interval of half a cycle of the modulation frequency. The zero readings are obtained at fixed intervals and are determined by the values for the velocity of light and the modulating frequencies.

Three Separate Frequencies

The Model 4 incorporates three separate frequencies in the 30 megacycle range, each producing a specific unit length. Because of the design of the instrument, and since the mathematical relationship between these three frequencies is held constant, distances up to 1000 meters can be calculated from the delay line dial readings.

The instrument is unable to measure distance in terms of total length, but it does indicate that the distance consists of even or odd 1000 meter intervals; i.e., the even intervals are 0-1000, 2000-3000, 4000-5000 meters, etc., and the odd intervals are 1000-2000, 3000-4000, 5000-6000 meters, etc. Since the Geodimeter does not identify the proper 1000 meter interval, it is necessary to obtain from maps or by other methods the approximate distance to within $\pm$ 1000 meters to calculate the observed distance.

The precision of the Geodimeter relies upon the fact that the velocity of light and the frequencies of the crystal oscillator are very accurately known and that they remain almost constant.

Changes in atmospheric temperature and barometric pressure produce a small known variation in the value of the velocity of light. Temperature and pressure data are noted for each observed line and the resultant corrections are applied to the computed distance.

Variations in frequency constants are caused by ambient temperature. In order to maintain fixed frequencies, the crystals are enclosed in an electrical oven where a constant temperature is maintained.

The Reflector

The simplest type of reflecting surface that could be employed is a plane mirror. However, such a reflector requires horizontal and vertical fine-adjustment motions since the reflected beam must be accurately directed toward the instrument. Any atmospheric refraction changes or tripod vibrations would make the reflected light unusable.

A special retrodirective reflector system which does not require accurate pointing was developed. The reflector is a two-inch diameter solid glass prism mounted in a metal case. This prism is actually a corner section of a cube. The 90 degree corner angles are ground to a tolerance of ± one second of arc. An exact corner prism, i.e., with corner angles being perfect right angles, is not desirable because it will reflect incident light directly back to the light source. Since the transmitter and receiver optics of the Geodimeter are laterally displaced, an exact corner prism would not be practical at short ranges. However, this deliberate deviation of the corner angles becomes less important as the range increases, and at ranges over a mile small optical imperfections in the prisms and turbulence in the air will spread the light sufficiently to account for the displacement of the transmitter and receiver optics.

Short Range Operation

Two methods have been devised for short range operation. The first is the insertion of a defined deviation in one of the 90 degree angles of the prism which causes the reflected light to return in two symmetrical light bundles at an angle with each other. One bundle will be centered on the receiver optics and the other bundle will be centered on a point symmetrically located on the other side of the transmitter optics.

The second method utilizes a thin glass wedge which covers half of a corner prism. A light beam entering the uncovered portion will be internally reflected in the normal way but will be deviated by the wedge when leaving the prism.

The development of the retrodirective prism system for use with the Geodimeter effected a huge increase in the number of observations that could be made each night. The prisms are easily portable and can be left unattended. In addition, light will be reflected to the instrument even though the axis of the prism is offset in its pointing by as much as 20 degrees.

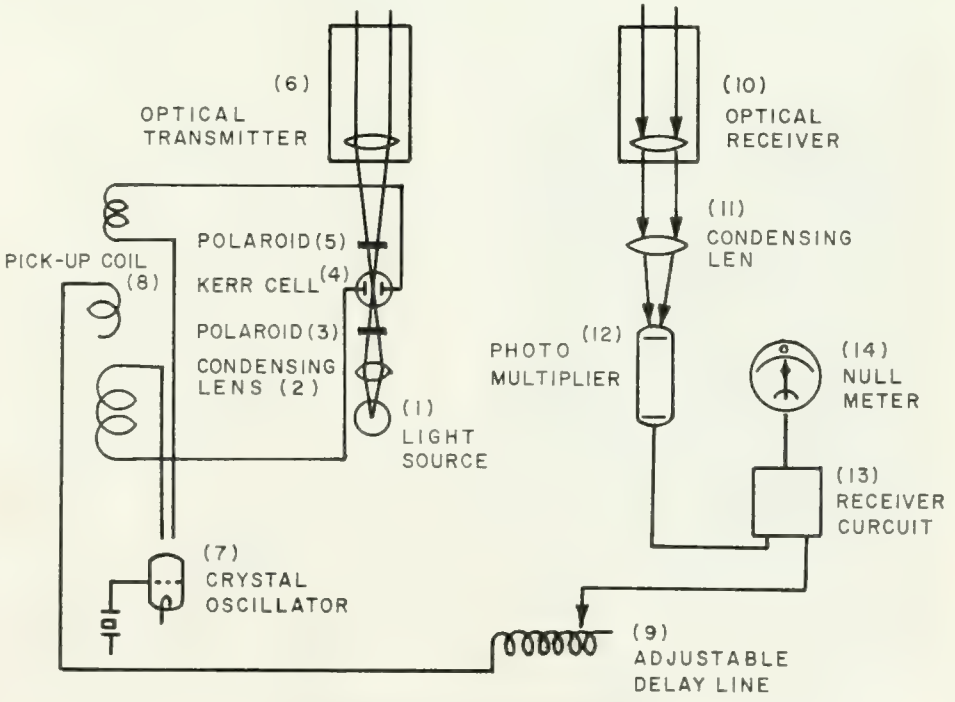
In order to afford the greatest flexibility and economy in operation each prism is mounted in individual shockproof casings which can be placed in housings that will hold 1, 3 or 7 prisms. The housings will mount on any Wild theodolite tripod, and with a special bracket a maximum of 21 prisms may be utilized. Plastic reflectors, similar to those used on highway guide posts, may be substituted for distances up to 0.5 mile. It is possible, therefore, to select the suitable reflector combination for the distance being observed.

The Model-2

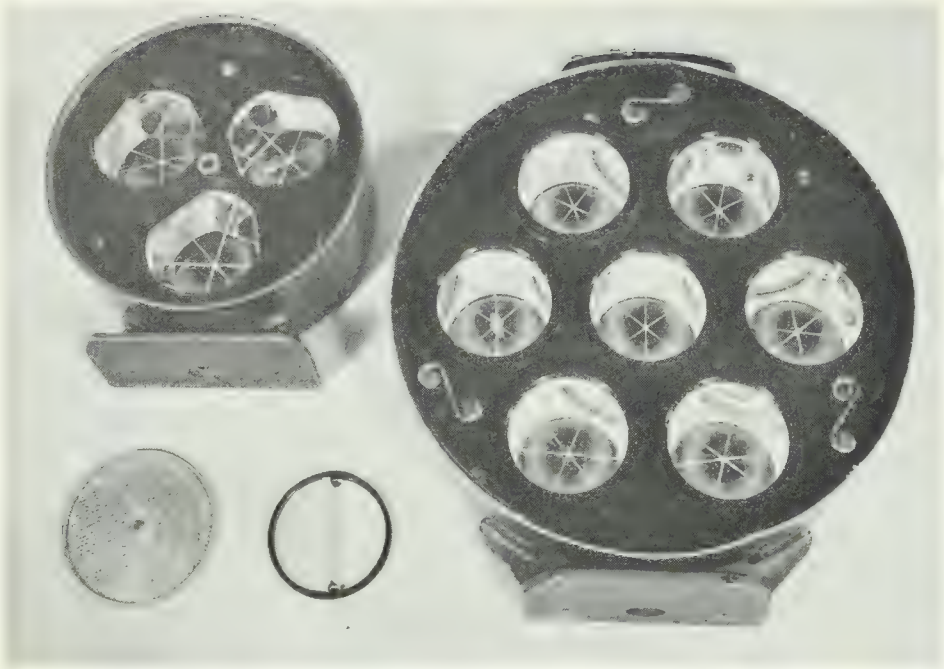
The initial model of the Geodimeter was developed for extreme accuracy at ranges from 5 to 40 miles. The Model-1 instrument was introduced in early 1953, and was superseded by a refined version, the Model-2 in 1955. The Model-2 Geodimeter gives results which are as accurate as the highest-precision taped distances. At the present time this instrument is being used by other agencies to establish first order base lines, and for determining the magnitude of the shift of the earth's crust in earthquake fault areas.

The Model-3

Many users of the Model-2 requested that a more portable unit be developed that would be useful in surveys that did not require utmost accuracy. Subsequent refinements of design, at the expense of range and accuracy, resulted in the production of the Model-3 Geodimeter. This model is designed to operate in the 1



Schematic diagram of the Geodimeter.



Various elements of reflecting unit, including 3- and 7-prism reflectors, plastic reflector, and glass wedge.

to 20 mile range, within a possible error range of ± 0.40 feet.

The Headquarters Model 3 instrument was used continuously for a 2½ year period during which time about 930 lines were measured. Although the instrument is still available for use it has been virtually replaced by the Model 4.

The Model-4

The Model-4 Geodimeter is designed primarily to meet the requirements for an instrument of high accuracy in the range of 1,000 feet to 4 miles. In clear air, distances up to 12 miles have been measured. At distances from 400 to 1,000 feet the accuracy is in excess of 1 part in 10,000, and the proportional accuracy increases as the distance measured increases. The maximum error for a single observation at any distance is ± 0.04 foot plus 5 millionths of the distance. Experiments conducted by the Headquarters staff indicate that the accuracy will normally be in the range of ± 0.02 foot using conventional operating techniques.

The components of this instrument consist of the Geodimeter, the head, power converter, and a Wild T2 theodolite tripod.

The instrument weighs 34 pounds and is 11 x 13 x 12 inches in size. The base, which is affixed to the tripod, weighs 10 pounds and is 5 x 7 x 7 inches in size. The power converter weighs 18 pounds and is 10 x 5 x 7 inches in size.

The power source may be either a small generator which supplies 110V at 60 c/s or a 6, 12, or 24 volt battery and inverter. The power consumption is 60 watts.

Approximately 1,500 lines were measured by the Headquarters party alone during the first year of operation of this model.

Need for the Geodimeter

As previously indicated the Geodimeter has proven to be especially useful in establishing the California Coordinate System in the immediate vicinity of highway mapping projects. While the instrument is now being used for a variety of survey problems, the initial interest in it was directly associated with the extension of the U.S. Coast and Geodetic Survey control network for the specific purpose of providing strong tie-points for the highway survey system.

This approach to control surveys was originally stimulated by the legislative enactment of 1947 which legally established the California Coordinate System. Following this, instructions were issued by Headquarters on July 21, 1948, requesting the districts to plan a gradual conversion of highway surveys into a coordinate system tied into the California Coordinate System. The cautious wording of the instructions signified that the task was expected to extend over a period of time.

There were at the outset two main difficulties which soon became apparent. The first centered around the lack of understanding of the California Coordinate System. While the federal government published information regarding the theory and use of plane co-ordinate systems derived from geodetic data, education and training were not readily available. Advancement of the Headquarters instructions of July, 1948, was inevitably slow, and depended upon the interest and effort of those intimately concerned with surveys. In 1951, the University of California Extension developed a course on the application of the California Coordinate System. This course, sponsored jointly by the Institute of Transportation and Traffic Engineering and the Division of Highways, and presented in different areas of the State, reached a wider cross-section of personnel and created greater general interest in the program.

Coast and Geodetic Survey

The second difficulty involved the practical problems associated with the field work necessary to use the U.S. Coast and Geodetic Survey network of triangulation stations. (The network has been developed for basically geodetic reasons and its use by other organizations has been, until fairly recently, of incidental consideration.) Because of the wide-spacing of the stations together with their remoteness throughout most of the State, routine surveying procedures familiar to highway personnel were not applicable. At that time personnel trained in geodetic surveying were not available, although attempts were made by different districts to organize specialized parties for this type of work. Varying degrees of success were achieved by highway survey parties, some showing disappointing results after completion of final computations.

The expanding use of aerial surveys and photogrammetric mapping emphasized the need to place the surveys on the California Coordinate System. In order to satisfy stereomodel scale requirements, especially for mapping large areas, horizontal control should be established on a suitable coordinate grid system. It seemed logical therefore, to specify in mapping contracts with private firms that horizontal control surveys be made on the California Coordinate System, and furthermore, that reasonably permanent monuments be located at sufficient intervals to make the surveys usable at a later date for locating and staking the final line and for right of way surveys.

Limited Progress

In this manner, progress was made in furthering the ultimate objective. However, where the U.S. Coast and Geodetic Survey triangulation stations were spaced more than five miles apart, which seemed to be the rule rather than the exception, the results were frequently dubious. The problem of establishing the California Coordinate System on all highway projects continued to be difficult to resolve.

With the advent of the Model 3 Geodimeter in 1957, instrumentation was at last available to extend the U.S. Coast and Geodetic Survey network into any area without resorting to complicated surveying procedures. Virtually all photogrammetric mapping projects are now placed on the California Coordinate System, and the surveys for design, location, and right of way, subsequent to the mapping, are also placed on the system. For all practical purposes the original instructions of July, 1948 have been carried out, and the conversion of highway surveys into a co-ordinate system tied to the California Coordinate System is rapidly becoming a reality.

Geodimeter Survey Operations

At the time the Headquarters' party was organized in September, 1957, surveying with electro-optical equipment was being done by a few federal agencies. These surveys were generally restricted to base line determinations. The use of electro-optical equipment for other phases of control surveying had been relegated to discussions of probable uses until such time as an economically feasible model was produced for short range measurements.

Thus, when the Model 3 became available a major pioneering effort was a necessity for much had to be learned about personnel requirements, auxiliary equipment, reconnaissance and preparation for the survey, and of course operation and maintenance of the instrument. In other words, the entire operational approach had to be investigated to establish practical procedures.

J. D. Carter, who was largely responsible for the intial interest in and for the ultimate success of Geodimeter surveys, was the first Chief of Party. Carter left state service in the spring of 1959 and his duties were assumed by Dan Radmanovich. Until recently this party operated on a statewide basis as a service to district offices, but it is currently being used for only four districts since the remaining seven now have their own facilities.

U.S. Coast and Geodetic Survey

As previously stated, the Geodimeter was initially acquired for the express purposes of extending the basic control of the U.S. Coast and Geodetic Survey into the project area. This extension of basic control provided strong check points for originating and terminating primary control surveys, that is, the establishment of co-ordinated monuments at intervals of 1,000 feet to 2,000 feet through the length of the project by conventional traverse procedures. Surveys have also been completed for special projects, an example being the Benicia-Martinez Bridge, which require very high order accuracies.

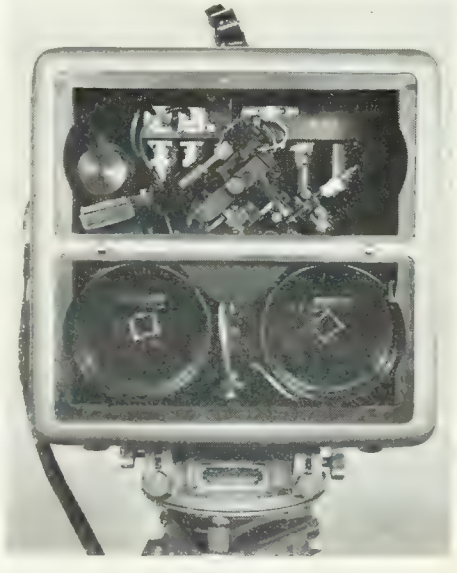
Of special interest was the co-operative work with the U.S. Coast and Geodetic Survey for establishing horizontal control along most of the length of the Westside Freeway from Wheeler Ridge in Kern County, north through Sacramento to Orland in Glenn County. (The section from 31 miles north of Kettleman City to Tracy was accomplished entirely with state forces.) The service agreement * required that geodetic markers be located at intervals of 2.5 to 5 miles along the length of the route. The U.S. Coast and Geodetic Survey was responsible for the entire survey, and they accordingly made the reconnaissance, located the monuments, erected observation towers, observed all horizontal angles, and completed all the geodetic position and adjustment calculations. All distances were measured with the Model 3 instrument by our own party, a deviation from usual procedures especially since the U.S. Coast and Geodetic Survey resorted to traverse rather than to triangulation methods for making the survey, mainly because of the reliability of the equipment.

The overall operational approach has been in practice for several years, although refinements continue to be developed to increase productivity. The following remarks apply in general to present practice by Headquarters using the Model 4.

Personnel

Personnel requirements are flexible, depending mainly upon the type of survey, its extent, and the nature of the terrain. The basic party may con-

* Under the procedures prescribed in the U.S. Bureau of Public Roads, Policy and Procedure Memorandum 20-9, co-ordination of this work with the U.S. Coast and Geodetic Survey was authorized, with participating federal funds.



Front of Model 4 Geodimeter, showing transmitting and receiving optics in lower half. The upper half, cover removed, shows light source and Kerr-cell in sloping position.



Night set-up showing value of reflectors and reflector tape in keeping track of equipment in dark.

sist of two men, the operator and a reflector attendant. For traverse-type surveys, the party usually required consists of the operator and his assistant and two reflector attendants. In areas of hazardous terrain, or where long packs to the stations are necessary, additional men are used with each reflector to provide a greater safety factor.

Equipment

The auxiliary equipment is generally divided into the following categories: electric power, vehicles, communications, survey instruments, and miscellaneous items.

Electric power is furnished by either a generator or a storage battery. The generator is a portable type, driven by a two-cycle gasoline engine, specially designed to produce a smooth current of uniform voltage. This generator is normally reserved for pack stations. The storage battery in the vehicle is suitable for nearby set-ups, but an inverter must be connected into the line to transform the current from DC to AC. Vehicles equipped with alternators permit rapid battery recharge when moving between set-ups.

Two four-wheel drive station wagon-type vehicles are used to transport the complete assembly of equipment and to provide transportation during operations. These vehicles are equipped with front end winches, tow hooks, and flashing red lights for obvious safety reasons. On the job, one vehicle is retained by the observing party and the other is used by the reflector attendants.

Communication equipment consists of two-way mobile radios in each of the vehicles, supplemented with handie-talkie radios for pack stations.

Other Equipment

Instruments, such as a one-second directional theodolite for measuring vertical angles, and a steel tape for measuring offsets and height of instrument, barometers and thermometers for atmospheric corrections, are necessary for the complete distance measuring operation.

Miscellaneous items are comprised of tools and spare parts to repair the Geodimeter and generator, and the usual surveying paraphernalia of axes, saws, machetes, flagging, etc. Special consideration is given to safety equipment for night surveying, such as fusees, blinking lights, cones and signs.

Reconnaissance

The fundamental requirement for Geodimeter observations is a clear line of sight, just as is required for theodolite observations. It is especially important that a thorough reconnaissance verify the feasibility of office planning, finalize the layout of the survey, and routes to stations chosen and marked adequately so that a minimum amount of time will be necessary to locate the stations in the dark.

Since the accuracy of the Model 4 is high at both short and long distances, any combination of lengths of courses may be utilized which greatly simplifies setting a random contro traverse. However, the daytime planning of monument location, trai marking to the stations, and notices tc law enforcement agencies and property owners that night surveys are being conducted is critical. The speec with which observations can be made is of no value if stations cannot be easily located and occupied at night

Monuments are set on ridges or at some predetermined approximate interval to eliminate the need for chaining on control traverse lines and tc reduce the need for chaining on fina location centerlines. Observations are made to basic control points and tc property corners or other points as may be required by the location and planning staffs. In extremely difficult terrain, the accuracy of the Geodimeter permits its use on courses of 400 to 600 feet which can eliminate many survey problems associated with single point ties.

Observation Procedure

At the Geodimeter station the initia setup is made in approximately five minutes. The assistant operator connects the power pack and voltage regulator to the source of electrica supply. He then sets up the theodolite at a convenient distance away from the instrument for measuring the vertical angle between stations during the observation.

The operator sets the tripod over the station, attaches the head to the tripod, and checks the plumb. The Geodimeter is then locked to the head and the power pack is connected to it The power is switched on and while the instrument is warming up, observation sheets are prepared and the height of the instrument is recorded

The reflector attendant plumbs a tripod over his station, attaches a re flector to the tripod and points the reflector toward the Geodimeter.

Communications between the stations are accomplished by utilizing

nobile and handie-talkie radio equipment.

When the instrument and reflector are set up the operator may locate the reflector by simply scanning the area, n which it is located, with a flashight. The reflector will return the ight beam and positive identification s made by blinking the light and observing and answering flash from he reflector.

Once the reflector is located, the lashlight is held alongside the Geodimeter and the instrument is pointed nd focused with the aid of a high owered telescope which is part of he transmitter-optical system. Fine ointing is accomplished using conentional tangent screws.

A series of 12 to 24 readings are nade for each distance determination. requiring 5 to 15 minutes. Midway hrough the readings temperature, ressure and offset data at both the nstrument and reflector stations are oted.

The observation time is completely ndependent of the length of line eing measured. The skill of the oprator and the degree of accuracy esired are the governing factors in ead-out time.

The usual production in a traverseype survey will range from 14 to 20 ines, although under ideal conditions s many as 40 lines have been oberved in a single night. The largest ime-consuming factor in Model 4 surveys is the interval needed to move rom station to station. The length of his interval depends on the ease with hich stations can be located and ocupied. It is therefore evident that the roduction of a Geodimeter survey arty is directly proportional to the ffort expended in the daytime planing and preparation of the survey.

Computations

The Geodimeter measures a line-ofight, or airline distance, which is eldom truly horizontal. Reduction of he slope distance to horizontal disance is based upon either the observed ertical angle or the measured differnce in elevation between the Geodimter station and the reflector station. or a long line the earth's curvature nd atmospheric refraction must be accounted for in the computation of horizontal distance. Further reductions of this distance to sea level and to grid are required for survey computations on the California Coordinate System.

Computation of distances are routine but time consuming, especially if attempted in the field. A computer program has been developed by the Highway Planning Survey Tabulation Section for electronic machine computation of the slope and horizontal distances.

Advantages

One of the most significant benefits achieved by the Model 4 occurs in surveys in urban areas. With its great flexibility it is possible to observe from street to street or through residential areas without having to enter upon private property as is necessary in ordinary chaining procedures. In short, the elimination of chaining effects the greatest savings in time and money.

The primary advantage of the instrument lies in the fact that the results achieved are positive. The validity of the raw data is established by the operator during the observation. The computations are also self-checking, and any incorrect solutions are, in almost every case, the result of blunders made in reducing the field notes and transcribing the data to the computation forms. However, experienced computers can resolve virtually every possible field or office error. As an illustration, the Headquarters' party has had to reobserve only three lines in over five thousand Geodimeter measurements.

Expanded Use of the Model 4

The apparent advantages of the Model 4 created greater interest in its application to a variety of surveys, examples of which are, as follows:

- (1) Bridge surveys requiring high order of accuracy.
- (2) Primary control surveys establishing monumented positions at intervals of 1,000 to 2,000 feet in flat to rolling terrain prior to mapping.



Dan Radmanovich, Instructor, at lectern, conducting Geodimeter course for Division of Highways employees. Around table, from left foreground, men are (number indicates district) John Linn, III; Frank Leithold, X; Dave Olson, X; Jim Bell, VI; Wally Greenwood, VII; Jim Westling, VII; Ralph Swingle, VII; Harold Fisher, VI; Don Goodman, III; Bob McClary, I; Larry Mohr, Headquarters; Barry Rockwell, Headquarters; Gary Alkire, I.

- (3) Primary control surveys establishing monumented positions at intervals of 400 to 500 feet in very rugged terrain prior to mapping.
- (4) Right of way surveys.

The demand for Geodimeter surveys continued to increase. Because of heavy workloads, Model 4 equipment had been purchased by the District IV Office in September 1959 and by the District XI Office in January 1961.

By the spring of 1961 it was evident that the Headquarters party did not have the capacity to continue its service to the nine remaining districts. In order to properly assess need versus capacity, a circular letter was issued in May 1961, requesting the districts to submit data regarding past experiences with and proposed future uses of the Geodimeter. The resultant evaluation of the answers to the circular letter revealed that certain districts would be better served if they possessed their own equipment.

It was subsequently recommended that Districts I, III, VI, VII, and X purchase separate Model 4 equipment to fullfill their own requirements. A training program for personnel assigned by each of the five districts was conducted by the Headquarters Photogrammetry Section in late September 1961. The program covered all phases of Geodimeter operations, calculations, repair and maintenance.

Districts II, V, VIII, and IX continue to be served by the Headquarters Party.

New Developments and Conclusions

The use of the Model 4 Geodimeter for daylight surveying, using existing equipment, has been limited to distances up to one mile. The problems encountered in current daylight operation results in a productivity loss of approximately 50 percent and has been considered economically unfeasible.

The manufacturer has recently developed a new light source which can be incorporated into the existing Model 4 to convert it to a daylight-operating instrument. It is reported that under normal conditions distances up to 5 miles can be measured in daylight and that the night range is extended to 20 miles. The daytime productivity is anticipated to be approximately the same as for nighttime observations.

As a daylight instrument the Model 4 will be applicable for many routine surveying jobs which cannot be safely or conveniently accomplished at night. However, actual operational results are not currently available, but they will be reported as soon as users have had the opportunity to test and evaluate the new version of the equipment. Obviously all users are hopeful the new version proves completely successful.

Another development hopefully anticipated is electronic equipment which will be capable of measuring distances directly, without the need for computation other than unavoidable atmospheric corrections similar to temperature corrections applied to taped lines. The ultimate goal is to eliminate the tape where ever possible, or at least to greatly reduce the need for a tape.

James E. Martin

James E. Martin, Executive Assistant to Edward T. Telford, Assistant State Highway Engineer in charges of District VIII, died as a result of a heart attack at his home in Whittier on March 24. He was 42 years old. His state career began in June 1948, when he went to work in District VII as a Junior Civil Engineer. He rose rapidly through the engineering grades while carrying out assignments in Construction, Design and Programs and Budgets. He became a Senior Highway Engineer in November 1955, and was promoted to Supervising Highway Engineer January 1, 1961.

A native of Prosser, Nebraska, Martin came to California as a boy. He attended Whittier High School, studied at Fullerton Junior College, and then at California Institute of Technology where he received his degree of bachelor of science in civil engineering.

Martin is survived by his wife, Alberta, a daughter and two sons, and his mother, Mrs. Thomas Kiley of Lakewood.

Foundations Expert Arthur Root Retires

Arthur W. Root, Supervising Ma terials and Research Engineer witl the Division of Highways in Sacra mento, retired on May 1, ending career of nearl 34 years with th State.


ARTHUR W. ROOT

Root had bee head of the Foun dation Section o Divisions' Material and Research Lab oratory since 1947 He is an authorit in the field of high way foundations, cut slope design an landslide analysis and treatment. He i coauthor of the Highway Researc Board book "Landslides and Engineer ing Practice" and is a member of sev eral national committees of the boarc

He also played an important part i the development of the first special ized drill rig used for installing hori zontal drains, a machine that has bee widely copied by manufacturers o drilling equipment.

Root is a native of Valley City North Dakota, where he attende grade and high school. He studied en gineering at the University of Orego and the California Institute of Tech nology.

Root joined the Division of High ways in 1928 as an axeman on con struction surveys. Later he served a assistant resident and resident enginee on highway construction in District IV (San Francisco), III (Marysville) IX (Bishop), and I (Eureka).

He was appointed District Materia Engineer of District I in 1938. H transferred to the Materials and Re search Department in Sacramento a head of the Foundation Section i 1947 and was promoted to Supervis ing Engineer in 1950.

Root is a member of the America Society of Civil Engineers, the Masoni Lodge and the Toastmasters Club.

Root and his wife, Clarene Ida, pla to move to Sebastopol on the Russia River following his retirement, wher he will spend much of his time boat ing, fishing and training dogs.

Span Lift

Novel Method Used to Raise San Gabriel River Bridge

By G. C. SMITH, Senior Bridge Engineer



THERE are two ways to raise an object—pull it up or push it up. The usual way to lift very heavy structures such as buildings or bridges is to push them up using hydraulic, screw or ratchet jacks.

Flood control work in the San Gabriel River channel required raising the State Highway Bridge across the channel on US Route 101 near Long Beach about 5½ feet. The bridge, which is on 2,000 foot radius, consists of seven, 57′ simple spans of T-beam design resting on concrete piers supported on piles; it is divided along center line by an expansion joint.

Novel Raising Method

In order to raise the bridge, the contractor decided to depart from the conventional and pull it up. Several factors influenced this decision. First, jacking from the bent caps was not possible, since the end diaphragms were not of adequate strength, and jacks could not be placed under the girders because of space limitations. Second, the channel at this point is in tidewater range, making cribbing from the ground impracticable. Consideration was also given to driving piles through holes in the deck, and constructing falsework on these piles to furnish the necessary jacking reaction.

Jacking Unit Described

Lifting was done using equipment originally developed to raise pre-cast floor slabs in building construction. Each jacking unit consists of two high-strength threaded steel rods, threaded sleeves, and a hydraulic motor (Fig. 2). The rods extend through the threaded sleeves and down to the load to be raised. The sleeves are turned by the hydraulic motor, thus

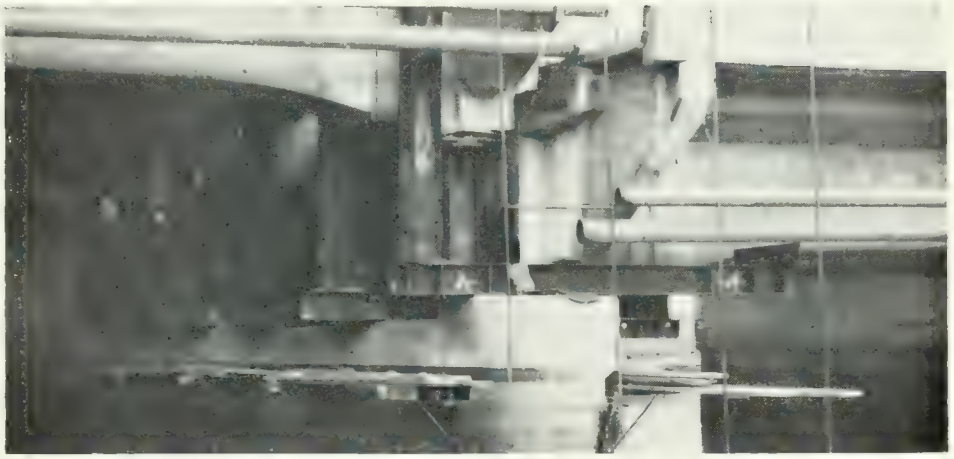


Figure 1. Steel bent in place on horizontal beams. The span to the left is fully raised. The permanent steel frame is in place.



Figure 2. Jacks in place on the steel bent after the span has been raised. The operating console is in the foreground.

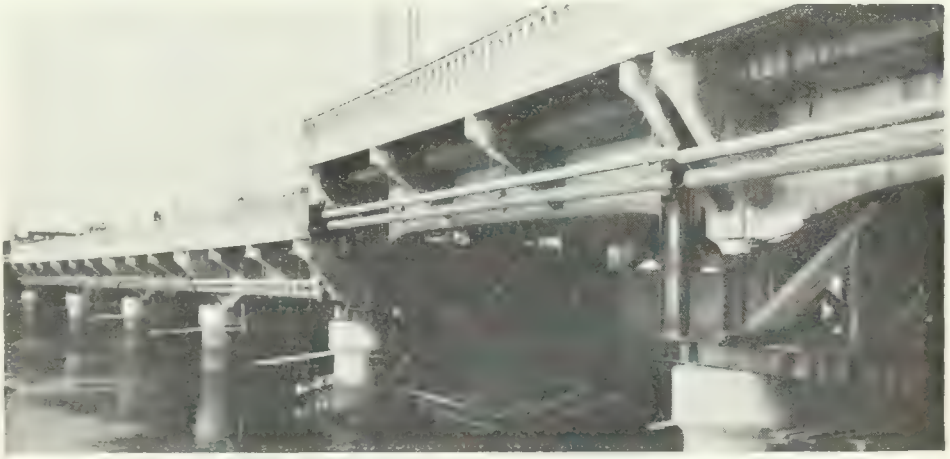


Figure 3. A general view of the bridge partly raised. The lifting jacks are still in place at the span in the center. At the bent in the foreground the reaction is shown carried to a raised span.

raising or lowering the rods, which do not turn. An electric revolution counter is connected to the sleeves in each jack. All operation of the jacks is done from a central console (Fig. 2); the revolution counters feed to this console enabling the operator to maintain uniform travel of the lifting rods at all units.

Steel Bent Used

Jacking reaction was furnished by a steel bent made up of wide-flange beams welded and braced, the legs of which extended, through holes in the deck (Fig. 2) to beams resting on the existing concrete bent cap (Fig. 1). As can be seen in Figs. 1 and 3, these horizontal beams were extended to blocking in the adjacent span. The ratio of length of beam under the adjacent span to that under the moving span was about 2:1, thus insuring adequate reaction.

After lifting the span into place, prefabricated steel posts (Fig. 1) were set under each end of the span, cross-braced with welded members, and the jacks released. These frames became a permanent part of the structure; Class "A" concrete was placed around them to extend the existing cap up to the new bearing elevation.

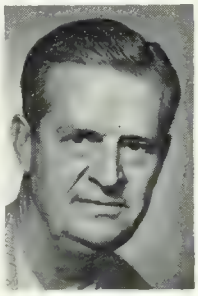
Lifting Time Reduced

It may seem that the amount of preparatory work to lift a span by this method is considerable. Compared to jacking from the existing caps, or from crib stacks on the ground, the device used cannot compete. It will, probably, about equal falsework on driven piles. The outstanding feature of the system employed, however, is that the actual lifting time, instead of several hours as would be required with jacks, was about 45 minutes.

Work was done by Peter Kiewit Sons Co. under contract with the U.S. Engineering Dept. as part of a project to improve the lower San Gabriel River channel. Plans for the method and equipment utilized in raising the bridge were reviewed by the Bridge Department under the direction of J. E. McMahon, Assistant State Highway Engineer.

ASSISTANT F.A.S. CHIEF TOM REYNOLDS RETIRES

Thomas W. Reynolds, Senior Highway Engineer in the Federal Aid Section of the State Division of Highways in Sacramento, retired on April 30. He had been with the State 31 years.


T. W. REYNOLDS

As assistant chief of the Federal Aid Section, Reynolds has been concerned with the federal approval and co-operative state-federal financing of construction projects on California highways included in the federal road system. More than $273,000,000 in federal aid funds has been apportioned to California for highway improvements during the current fiscal year.

Reynolds joined the Division of Highways as a draftsman in 1931. Prior to that time he had worked as surveyor and draftsman for the Cities of San Diego and Oceanside and several private power and land companies.

Reynolds was transferred to the division's Financial Control Section in 1941 and to the Federal Aid Section in 1949.

He served as a lieutenant in the Navy Seabees during World War II.

Reynolds was born in Lexington, Kentucky, and attended grade and high school at Amsterdam, New York. He studied at Union College, Schenectady, graduating with a B.S. degree in civil engineering in 1922.

Reynolds and his wife, Madge, have a son, Thomas S., of Sacramento.

EXPRESSWAY TO FREEWAY

The State Department of Public Works has awarded a $781,771.30 contract for constructing an interchange at Madonna Road and surfacing 2.7 miles to convert from expressway to four-lane freeway on US 101, between two-tenths mile south of Los Osos Road and four-tenths mile north of Marsh Street in San Luis Obispo.

This is one of a series of budgeted expressway - to - freeway conversion projects which will provide 19 miles of continuous full freeway from north of San Luis Obispo to Arroyo Grande.

Giles H. Lamb

Giles H. Lamb, Materials Engineer for the Division of Highways District Office in Los Angeles, died on April 14. He was 62.

A native of Yates Center, Kansas, Lamb studied at the University of Kansas where he was awarded a B.S. in civil engineering in 1922.

After graduation, he was first Assistant County Engineer of Douglas County, Kansas, and then County Engineer of Chase County.

He joined the California Division of Highways in 1930. Prior to his appointment as District Materials Engineer of the Los Angeles District in 1945, Lamb served as resident engineer on construction projects and carried out special studies on construction methods and materials.

He was the developer of the "tow float" method of finishing portland cement concrete paving. Between 1936 and 1941 he conducted a study of the cost and efficiency of seawall protection at Point Mugu and Little Sycamore Creek in Ventura County.

As Materials Engineer he has conducted studies on slope stability, slides, sources of mineral aggregate, quality control tests, settlement and seepage on state highway construction projects in Los Angeles, Orange and Ventura Counties.

Lamb was promoted to Senior Highway Engineer in 1950.

He was a member of the American Society of Civil Engineers and the American Society for Testing Materials. He was a Mason and served in the U.S. Army during World War I.

He is survived by his wife, Eva May, and a son and daughter.

MONTEREY BUILDING ADVERTISED

The Division of Architecture has advertised for bids on construction of permanent headquarters facilities for the Division of Forestry and the Division of Beaches and Parks at Monterey. Five buildings, mainly of frame construction, with an aggregate floor area of 46,000 square feet, are involved. Approximate cost of construction is $500,000.

Thomas E. Stanton

Thomas E. Stanton, former Divi-on of Highways employee, died at is home in Belvedere on April 30. He as 81.

A man widely known in engineer-ng circles, Stanton served as Mate-ials and Research Engineer for the ivision for 23 years prior to his re-rement in 1961.

During his professional career, Stan-on was an active member of virtually ll American technical societies. He as a director of the American So-iety of Civil Engineers, 1937-1939, nd vice president in 1942-1943. He erved on the board of directors of he American Concrete Institute in 943-1944 and was elected an honor-ry member in 1955. Together with ther honors for notable contribution, e was awarded the Wason Medal by he American Concrete Institute in 934, and the Norman Medal by the merican Society of Civil Engineers n 1943; both for outstanding work n portland cement concrete, espe-ially for the discovery of the alkali-ggregate reaction.

He was one of the leaders in organ-zing the California State Employees ssociation and the State Employees' etirement System and served as the ystem's first president.

Stanton was born in Los Angeles here he grew up and attended chool. His higher education was ob-ained at Saint Vincent's College from hich he was graduated in 1899 with n A.B. degree. He then attended the niversity of California at Berkeley here he received a B.S. degree in ining.

He was with the Los Angeles City ngineer's Office for seven years. He arted his career with the State Divi-on of Highways in 1912. Stanton as appointed in 1914 to the position f principal assistant division engi-eer in Sacramento. In 1920, he was ade assistant highway engineer in harge of general inspection through-ut the southern portion of the State. n 1921, when the Department of ublic Works was formed, Stanton as appointed assistant state highway engineer in which capacity he served until his appointment as materials and research engineer in 1928. He held this position for the succeeding 23 years until his retirement in 1951.

Following his retirement in 1951 he piloted the formation of a local Olive Growers' Association, and became its first president in 1951. While serving as the association's president, Mr. Stanton also served concurrently as president of the board of directors until March 1958. He also was active in the Rotary Club, the Del Paso Country Club and the Sutter Club.

He is survived by his son, Thomas E. Stanton, Jr., of Belvedere, and two daughters, Mrs. Henry F. Zacharias of Sacramento and Mrs. John F. Madden of Tiburon, as well as six grandchildren and one great-grandchild. He is also survived by a brother, Joseph E. Stanton, of Pasadena, and two sisters, Anna Stanton of Los Angeles and Mary Megan of Wilmington.

RECENT RETIREMENTS FROM DEPARTMENT LISTED

Headquarters Office

Paul M. Paine, Associate Highway Engineer, 18 years.

District I

James H. Trapier, Highway Maintenance Man II, 32 years.

District II

Herbert E. McCann, Senior Highway Foreman, 29 years.

District III

Edwin E. Robinson, Highway Maintenance Man II, 29 years; Earl H. White, Janitor, 9 years.

District IV

Pete Galli, Highway Maintenance Man I, 18 years; W. G. Remington, Associate Highway Engineer, 41 years; Thelma C. Rock, Senior Account Clerk, 10 years; Frances E. Smith, Intermediate Account Clerk, 17 years; Joseph E. Toohig, Heavy Power Shovel Operator, 30 years; Otis L. Watts, Engineering Aid II, 7 years; Wesley W. Wiltsee, Highway Engineering Technician, 15 years.

District V

Harold N. Albaugh, Intermediate Clerk, 13 years.

District VII

Herbert E. Belford, Senior Highway Engineer, 40 years; Ralph V. Chase, Supervising Highway Engineer, 27 years; Leo C. Cunniff, Heavy Power Shovel Operator, 37 years; Harold J. Downs, Assistant Highway Engineer, 37 years; Mearl F. Evans, Building Maintenance Man, 19 years; Vladimir Fielder, Drafting Aid II, 7 years; Henry Hawthorne, Senior Highway Engineer, 40 years; J. Walter Trumpy, Assistant Highway Engineer, 15 years; Loral Wiley, Highway Maintenance Man II, 28 years.

District VIII

Frances V. Black, Supervising Clerk I, 15 years.

District IX

Carl D. Cleland, Highway Foreman, 35 years.

District X

Henry L. Pleau, Highway Foreman, 31 years; Orvis F. Roberts, Highway Maintenance Man I, 11 years.

State-Owned Toll Bridges

Mary M. Corbett, Senior Typist-Clerk, 30 years.

Materials and Research Department

Mary G. Forbes, Intermediate Clerk, 13 years.

Shop 2

John R. Foster, Machinist, 2 years.

Shop 4

Herbert V. Daugherty, Automobile Mechanic, 25 years; Albert J. Montijo, Automobile Mechanic, 36 years.

Shop 5

Walter H. Gaskin, Machinist, 28 years.

Shop 8

George C. Ulrich, Machine Parts Storekeeper, 26 years.

Shop 11

James R. Leisure, Mechanic's Helper, 25 years.

TWENTY-FIVE YEAR LIST

Headquarters Office
Charles V. Gay
Raymond S. J. Pianezzi

District I
Lawrence M. Finigan

District II
John Wesley Stone

District III
Jean N. Michelet
Charles R. Waugh

District IV
Ann M. Bernard
Melvin A. Frey
Raymond S. Head
Carl H. Johnson
Harold A. Petersen

District VII
Paul L. Weiss

District VIII
Camille Marchese
Chester H. Taylor

District IX
Ivadell M. Smith

District XI
Harold D. Martin

Bridge Department
Philip C. Harris

Materials and Research Department
Sam T. McCloy
George B. Sherman

$66 MILLION ROAD WORK

During March the Department advertised for bids on 62 highway projects with an estimated value of $66,068,800. There were 46 contracts for $26,247,800 awarded during the month and 29 contracts for $31,750,800 were completed. Bids were opened for 40 projects for which 245 contractors' bids were received, an average of 6.1 bidders per project.

Some of the steel sections built into the Bay Bridge towers weigh as much as 78 tons and the average is about 50 tons. Specially built railroad cars were required to transport the heavier sections to the waterfront to be loaded on barges.

Construction Index Shows Cost Decrease

The California Highway Construction Cost Index for the first quarter of 1962 stands at 235.7, a decrease of 2.8 index points or 1.2 percent under the fourth quarter of 1961.

This decrease in the index following an increase of 3.5 percent in the fourth quarter 1961, together with the small fluctuations for several years, indicates a continuing trend of stabilization in highway costs.

A similar trend is indicated by the behavior of the Bureau of Public Roads Composite Mile Index, which is based on Federal-Aid highway construction contracts awarded by the state highway departments. The index for the fourth quarter of 1961, which is the latest available, increased 2.3 percent. This index also has shown only small fluctuations during the past few years.

The Engineering News-Record Construction Cost Index for the first quarter of 1962 increased 1.4 points or 0.4 percent over the previous quarter.

Bidder competition during the first quarter of 1962, with an average of 6.4 bidders per project, is practically unchanged from the previous quarter (6.5).

Vehicles in U.S. Total 75 Million

Motor vehicle registrations in the United States totaled 75,846,532 during 1961, state agencies have reported to the U.S. Bureau of Public Roads. Federal Highway Administrator Rex M. Whitton noted that this was a gain of 2.1 million vehicles over the 1960 registrations. The 2.8 percent rate of increase is slightly less than the 3.2 percent increase of the preceding year.

The 1961 total included 63,274,481 passenger cars, 280,686 buses, and 12,291,365 trucks. Increases over comparable figures for 1960 were 2.6 percent for passenger cars, 3.1 percent for buses, and 2.9 percent for trucks.

IN MEMORIAM

District I
Kenneth M. Nelson, Assistant Highway Engineer

District III
Paul W. Westerman, Assistan Highway Engineer

District IV
Bernyce M. Moore, Intermediat Typist-Clerk

District VII
Elmer W. Honaker, Highway Traffic Signal Technician
James E. Martin, Supervising Highway Engineer
Peter B. Newmeyer, Junior Righ of Way Agent

District VIII
John M. Harris, Highway Engineering Technician II

District X
Joseph S. Curley, Engineering Aid

Bridge Department
Frank J. Smith, Assistant Bridg Engineer

State-Owned Toll Bridges
Milton A. Jones, Toll Collector

Shop 7
Henry C. Brown, Heavy Equip ment Mechanic
Hamilton H. Payne, Automobil Mechanic

Hearing Held on Coronado Crossing

The Department of Public Work held an informational public hearin in Coronado on June 6 on possibl routes for a proposed toll crossing be tween San Diego and Coronado.

Purpose of the hearing was to ac quaint the people of the San Dieg and Coronado area with several alte nate routes for a tube or bridge cross ing on which feasibility studies hav been made. The toll crossing is in tended to replace the existing ferr service.

The hearing was another step in series of studies carried out by the de partment in accordance with instruc tions of the Legislature.

Melbourne West

Melbourne H. West, engineer of ty and cooperative projects for the ivision of Highways, died suddenly n June 11, while spending the week- nd in the Lake Tahoe area.

West, 56, had been an employee of ie division since his graduation from ie University of California in 1928, xcept for military service in World Var II.

He was born in Madison, Illinois, ut grew up in Fresno and attended igh school there. His first work with ie Division of Highways was in Dis- ict VI and then in District XI in arious aspects of location and design.

In 1940, he entered active army uty as a captain in the Coast Artillery orps. He was at Pearl Harbor in De- ember 1941 and continued to serve the Hawaiian Islands for much of ie war. He was released from service 1946 as a lieutenant colonel, Gen- al Staff Corps.

Returning to District XI, West pecialized in traffic engineering. He erved as district traffic engineer from 948 until he was promoted to assist- nt planning survey engineer in Sacra- ento Headquarters office in 1955.

In the latter capacity, he had an ctive part in the development of the Senate Concurrent Resolution 26" eport in 1958 which was the basis for ie 1959 legislation establishing the alifornia Freeway and Expressway ystem.

On November 1, 1958, West was romoted to the rank of principal ighway engineer and appointed en- neer of city and co-operative proj- ts. In this capacity he was responsi- e for administering and supervising e apportionment and expenditure of e ⅝-cent-per-gallon portion of the ate gasoline tax which goes to Cali- rnia's 377 incorporated cities for nstruction and maintenance on local ty streets. Currently this apportion- ent amounts to about $35,000,000 a ear.

West was a member of the Institute Traffic Engineers, and a graduate 946) of the Yale University Bureau Highway Traffic. He was an asso- ate member of the Highway Research Board, National Academy of Sciences. He played violin in the Sacramento Symphony Orchestra.

He is survived by his wife, Suzanne, and by three children, David, Stephen and Christine.

LETTER CITES HIGHWAY FOREMAN'S FAST THINKING

March 29, 1962

MR. SAM HELWER, *District Engineer*
District I, Division of Highways
P.O. Box 1012
Eureka, California

DEAR MR. HELWER:

We wish to call to your attention the valuable, helpful and excellent services and assistance rendered by your Division of Highways Foreman, Calvin Jackson, Gasquet, California, to our Officer Jackson O. Murphy and the three injured victims of a spectacular motor vehicle accident which occurred on Oregon Mountain, US 199-1-E on the night of March 26, 1962, 42 miles east of Crescent City.

The accident vehicle ran off the roadway down a 90 percent grade and smashed into a large stump 150 feet below the roadway. Two of the injured victims were trapped in the totally wrecked vehicle, one of whom was suffering from several broken ribs, punctured lung and possible broken back.

Laboring under the extremely hazardous conditions of darkness, steep and extremely muddy and slippery canyon slopes, coupled with the danger of the accident vehicle teetering against the stump dislodging and tumbling several hundred feet further down into the canyon, Officer Murphy assisted by Foreman Calvin Jackson and others were successful in safely removing the injured persons and carrying them on stretchers up the extremely steep slopes to the roadway where the ambulance awaited.

Our Officer J. O. Murphy, collapsed, after getting the last victim to the ambulance, from what was believed at first to be a heart seizure resulting from overexertion due to the strenuous activity involved in the rescue operation.

Foreman Calvin Jackson, assisted by Mr. Norman Wier, County Coroner, acted swiftly and with remarkably good judgment, loaded Officer Murphy into the patrol car, due to the fact that the ambulance was loaded with the accident victims, radioed an account of the circumstances to our communications center over the patrol vehicle radio, and with Mr. Wier administering oxygen to Officer Murphy, Foreman Calvin Jackson drove the occupants to Seaside Hospital in Crescent City, making arrangements en route via the CHP radio to alert the hospital and also provide for the presence of awaiting doctors upon their arrival, and the following ambulance, at the hospital.

Foreman Calvin Jackson is to be commended not only for his valuable and able assistance rendered to the California Highway Patrol at the scene of this accident, but most of all for his ability to take command of a difficult situation and execute a remarkable display of excellent judgment in such a thorough and calm manner that the entire incident and transportation of Officer Murphy was accomplished without further complication.

Officer Murphy has just been released from the hospital and joins this commander in extending our thanks and appreciation to Foreman Calvin Jackson for a job well done.

Very truly yours,

A. D. JOHNSON, Captain
Commander
Crescent City Area
California Highway Patrol

ADVERTISED JOB TOTAL

During April the department advertised for bids on 64 highway projects with an estimated value of $23,700,000. There were 45 contracts for $13,037,000 awarded and 47 contracts for $36,416,000 were completed. Bids were opened for 53 projects for which 263 contractors' bids were received, an average of five bidders per projects.

The new Retirement Building in Sacramento, which will be the fourth largest building west of Chicago, is scheduled for completion early in 1964.

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

HIGHWAY TRANSPORTATION AGENCY

ROBERT B. BRADFORD . . . Administrator

DEPARTMENT OF PUBLIC WORKS . . . ROBERT B. BRADFORD, Director

FRANK A. CHAMBERS . . . . Chief Deputy Director

RUSSELL J. COONEY . . Deputy Director (Management)
HARRY D. FREEMAN . . Deputy Director (Planning)

T. F. BAGSHAW . . . . . Assistant Director
JOHN H. STANFORD . . . . . Assistant Director

JUSTIN DuCRAY . Departmental Management Analy
S. ALAN WHITE . . Departmental Personnel Offic

DIVISION OF HIGHWAYS

J. C. WOMACK . . . State Highway Engineer, Chief of Division

CHAS. E. WAITE . . . Deputy State Highway Engineer
J. P. MURPHY . . . Deputy State Highway Engineer
J. A. LEGARRA . . Deputy State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
GEO. LANGSNER . . Assistant State Highway Engineer
FRANK E. BAXTER . Assistant State Highway Engineer
J. C. BURRILL . . . . . Comptroller
C. G. BEER . . Engineer of Federal Secondary Roads
L. L. FUNK . . . . . Planning Engineer
MILTON HARRIS . . . . . Construction Engineer
F. N. HVEEM . . . Materials and Research Engineer
SCOTT H. LATHROP . Personnel and Public Information
H. C. McCARTY . . . . . Office Engineer
A. M. NASH . . . . . Systems Research Engineer
E. J. L. PETERSON . . Program and Budget Engineer
F. M. REYNOLDS . . . . Planning Survey Engineer
EARL E. SORENSON . . . . . Equipment Engineer
E. L. TINNEY . . . . . Maintenance Engineer
W. L. WARREN . . . . . Engineer of Design
G. M. WEBB . . . . . Traffic Engineer
M. H. WEST . Engineer of City and Co-operative Projects
A. L. ELLIOTT . . . . Bridge Engineer—Planning
L. C. HOLLISTER . Bridge Engineer—Special Projects
I. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area

Right-of-Way

RUDOLF HESS . . . . . Chief Right-of-Way Agent
DEXTER D. MacBRIDE . . . . . Assistant Chief
RAY E. O'BIER . . . . . Assistant Chief
R. S. J. PIANEZZI . . . . . Assistant Chief
JACQUES T. ZEEMAN . . . . . Assistant Chief

District IV

J. P. SINCLAIR . . Assistant State Highway Engineer

District VII

E. T. TELFORD . . Assistant State Highway Engineer

District Engineers

SAM HELWER . . . . . District I, Eureka
H. S. MILES . . . . . District II, Redding
ALAN S. HART . . . . . District III, Marysville
L. A. WEYMOUTH . . . . District IV, San Francisco
R. A. HAYLER . . . . . District IV, San Francisco
HAIG AYANIAN . . . . District IV, San Francisco
E. R. FOLEY . . . . . District V, San Luis Obispo
W. L. WELCH . . . . . District VI, Fresno
A. L. HIMELHOCH . . . . District VII, Los Angeles
GEORGE A. HILL . . . . District VII, Los Angeles
A. C. BIRNIE . . . . . District VII, Los Angeles
A. W. HOY . . . . . District VII, Los Angeles
C. V. KANE . . . . . District VIII, San Bernardino
C. A. SHERVINGTON . . . . . District IX, Bishop
JOHN G. MEYER . . . . . District X, Stockton
J. DEKEMA . . . . . District XI, San Diego
CHARLES L. SWEET . . . . . Bridge Engineer
State-owned Toll Bridges

CALIFORNIA HIGHWAY COMMISSION

ROBERT B. BRADFORD . Chairman and Director of Public Works
ARTHUR T. LUDDY . . Vice Chairman Sacramento
JAMES A. GUTHRIE . . San Bernardino
ROGER S. WOOLLEY . . . San Diego
JOHN ERRECA . . . . . Los Banos
ABRAHAM KOFMAN . . . San Jose
FRANKLIN S. PAYNE . . Los Angeles
JACK COOPER, Secretary . . . Sacramento

DIVISION OF CONTRACTS AND RIGHTS-OF-WAY (LEGAL)

ROBERT E. REED . . . . . Chief Counsel

GEORGE C. HADLEY . . . . . Assistant Chief
HOLLOWAY JONES . . . . . Assistant Chief
HARRY S. FENTON . . . . . Assistant Chi

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

NORMAN C. RAAB . . . . Chief of Division
BEN BALALA . . . . . Principal Bridge Engineer

DIVISION OF ARCHITECTURE

EARL W. HAMPTON . . . Acting State Architect, Chief of Division

EARL W. HAMPTON . . . . . Deputy Chief, Architecture and Engineering
HUBERT S. HUNTER . . . . . Deputy Chief, Administrative
ARTHUR F. DUDMAN . . . . . Assistant State Architect (North
TOM MERET . . . . . Assistant State Architect (South
CHARLES M. HERD . . . . . Chief Construction Engineer

DIVISION OF AERONAUTICS

CLYDE P. BARNETT . . . . . Director, Chief of Division

printed in CALIFORNIA STATE PRINTING OFFICE 62728 5-62 48,700



bove: Federal Highway Administrator Rex M. Whitton is shown addressing a group of about 200 highway-minded community leaders from Southern California a luncheon served overlooking the construction area of the San Diego Freeway where it is being cut through the Santa Monica Mountains. The luncheon was the highlight of a National Highway Week tour on May 22.

Below: Some of the buses and cars used to transport the tour participants. View is south in the cut area from Mulholland Drive Overcrossing. Bridge in middle distance is Rimerton Road Overcrossing.



The observance of the second an-ıal National Highway Week, May)-26, 1962, was highlighted in Cali-rnia by widespread newspaper pub-city about freeway progress and eeway advantages in many areas of e State; by a construction tour and bsite luncheon on the huge San iego Freeway construction project the Santa Monica Mountains in Los ngeles; by exhibits and "open house," rticularly in the Los Angeles, Ven-ra, and San Bernardino areas; and special radio and television pro-ams.

National Highway Week May 20-26, 1962

ow: Typical of exhibits at State Highway Main-ance stations and other public buildings during tional Highway Week was this display of a del and enlarged charts and photographs at nta Ana. Assistant Highway Engineer James rie, at left, was on hand to explain details, wer questions, and give out maps showing freeway progress.



These were some of the methods by which Californians had the opportunity, in accordance with Governor Edmund G. Brown's recent statement calling attention to National Highway Week, to "inform themselves fully concerning the progress of our State Highway Program and its importance to our safety and prosperity."

In the San Francisco Bay area, newspapers published freeway progress maps for each of nine counties along with a detailed report of current projects. In Southern California the releases, issued by a special committee of highway-minded civic leaders, covered not only county-by-county progress but also the safety and economic benefits of freeways.

SEATTLE PUBLIC LIBRARY
4TH & MADISON
SEATTLE 4, WASHINGTON
R56

California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

RETURN POSTAGE GUARANTEED

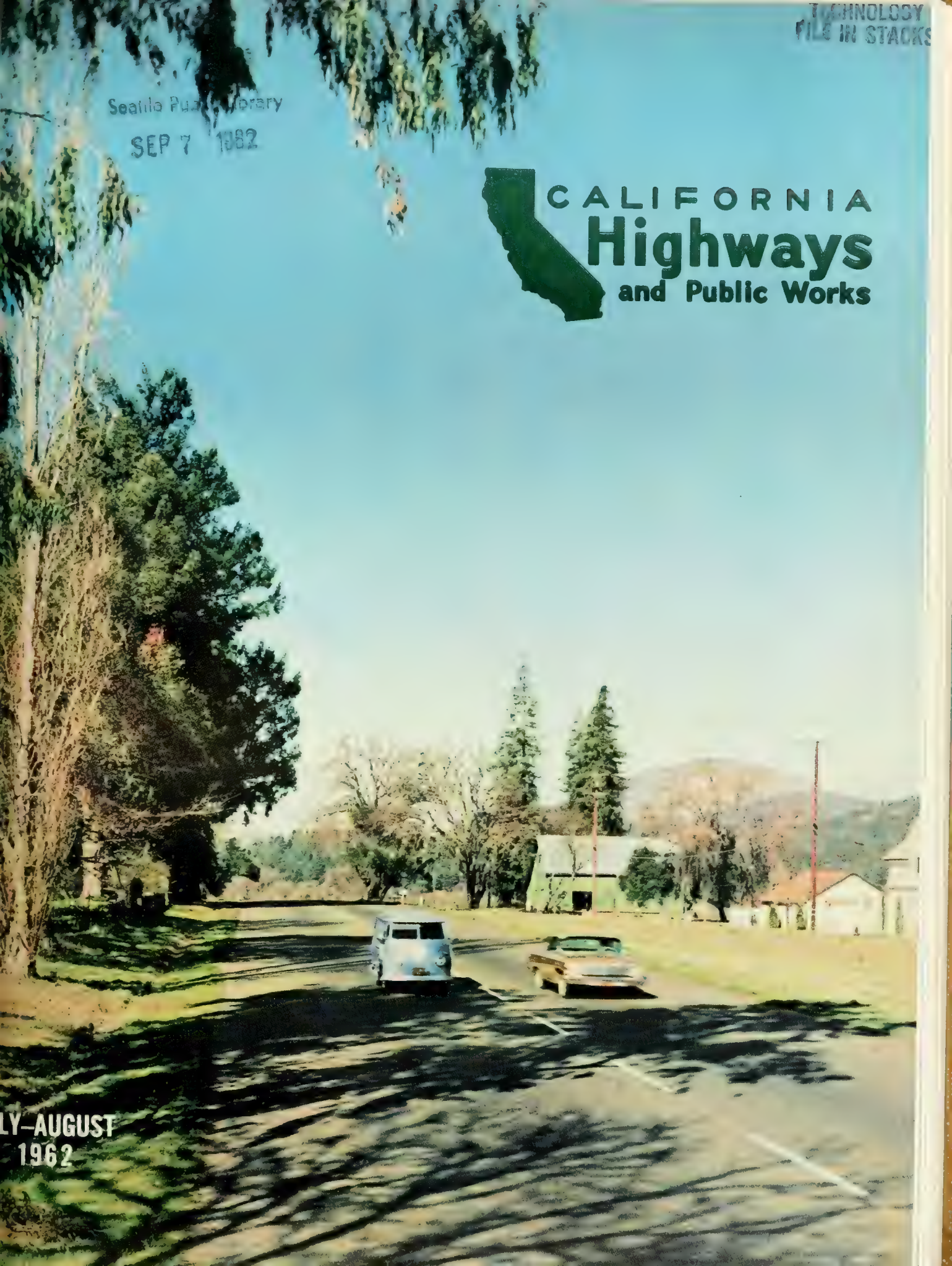
BULK RATE
U. S. POSTAGE
PAID
Sacramento, Cal
Permit No. 152



TECHNOLOGY
FILE IN STACKS

Seattle Public Library
SEP 7 1962

CALIFORNIA Highways and Public Works



LY-AUGUST
1962

Policy on Scenic Values

A recent study on a proposed scenic highway system made by the Division of Highways to the State Legislature indicated that there is need for classification of the present policy of the division regarding the development of scenic values along the state highway system. Therefore, in addition to the aesthetic design features already contained in the Design Section of its Planning Manual of Instructions, the division has thought it advisable to restate the scenic criteria that should be considered in location and design studies so that potential scenic values will be developed and preserved.

Basic Precepts

"In any highway, pleasing appearance is a consideration in the planning and design process. Scenic values must be considered along with safety, utility, economy and all the other factors considered in planning and design. This is particularly true of the many portions of the state highway system situated in areas of natural beauty. In such areas, the location of the highway, its alignment and profile, the cross-section design and other related features should be in harmony with the setting. Economy consistent with traffic needs will always be of paramount importance, although a reasonable additional expenditure can be justified to enhance the beauty of the highway itself.

Design Speed

"The design speed should be carefully chosen as it is the key element which directly fixes standards for the horizontal alignment and profile of the highway. These requirements in turn directly influence the manner in which the location of the highway blends onto the landscape. Scenic values, particularly in areas of natural scenic beauty, must play a part along with the factors set forth under Index No. 7-101.1 in selecting a design speed.

Aesthetic Factors

"In a natural scenic environment, consideration should be given to the following factors to insure the most satisfactory results from an aesthetic standpoint.

(a) The location of the highway should be such that the new construction will preserve the natural environment and will lead to and unfold scenic positions.

(b) The general alignment and profile of the highway should fit the character of the area traversed so that unsightly scars of excavation and embankment will be reduced to a minimum. Curvilinear horizontal alignment and a gently rolling profile consistent with design requirements will help to accomplish this.

(c) As an agreeable and natural roadside appearance is essential, the destruction of valuable trees and growth should be avoided if suitable alternative locations are available at reasonable cost.

(d) Whenever feasible wide medians, curvilinear alignment and independent roadways should be provided on multilane facilities as these features add scenic interest and relieve the monotony of parallelism.

(e) Bridges, tunnels and walls merit consideration in lieu of prominent excavation and embankment slopes when costs of such alternatives are not excessive.

(f) Slopes should be flattened whenever practical and ground cover provided so that lines of construction are softened and beautified.

(g) Structures should be located and designed to give the most pleasing appearance.

(h) Scars from material sites should be avoided. Planting in harmony with the surroundings should be undertaken to screen such scars when they are unavoidable.

(i) Drainage appurtenances should be so located that erosion, sumps and debris collection areas are hidden from view or eliminated when the nature of site conditions permits.

(j) Interchange areas should be graded to provide an expanse of naturalistic easy flowing contours. The resulting pleasing appearance can be further enhanced by indigenous growth or by planting a vegetative cover appropriate to the locality."



PHOTO LEFT—US Highway 97 in Siskiyou County looking south with Mount Shasta in the background.

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

Vol. 41 July-August 1962 Nos. 7-8



FRONT COVER—This two-lane section of Highway 29-128 south of Calistoga, in the charming Napa Valley, is a freeway, by legal definition. Access is controlled, and provision has been made for an eventual four lanes. See "Two-Lane Expressways," page 11. (Photo by John Meyerpeter.)

BACK COVER—The Golden State Freeway in Los Angeles looking south from the Griffith Park Road Overcrossing shows the kind of road the average person thinks of when the name "freeway" is mentioned. (Photo by Bob Dunn.)



CONTENTS

	Page
MacArthur Freeway By J. B. Watson, Assistant District Engineer, and J. D. Collins, District Construction Engineer	2
Hewes Award	8
Two-lane Expressways	11
Moonlight Ride	19
Traffic Engineering Award Presented to the Division	20
Traffic Census By Thomas N. Tamburri, Assistant Traffic Engineer, and Carroll E. Dunham, Associate Highway Engineer	21
Tolls Adopted for New State Bridges	28
Central Mix By J. O. Kapono, Assistant Highway Engineer	29
Final Route Link	33
Staff Promotions	35
State Launches Broad Motor Vehicle Study	36
C. G. Beer and C. T. Ledden Named to New Posts	36
Petaluma Bypass By James H. Hampton, Right-of-Way Agent	37
Illustrated Booklet Explains Road Work	44
Reduced Plans By Harry Choi, Special Services Highway Engineering Associate	45
Full Freeways Now Total 1,000 Miles	48
Evaporation Rate By Rufus M. Hammond, Assistant Highway Engineer	49
Safety Foundation Marks 25th Birthday	53
Twenty-five-year List	54
Division Exhibits Publications at State Library	55

Retirements

Albert C. Briney	54	A. A. Hilton	55
H. T. Forschler	54	Richard H. Ramsey	55
Frank F. Green	54	Cass M. Rose	52
Helen Halsted	18	Department List	53

Obituaries
In Memoriam 54

LESTER S. KORITZ, *Editor*
STEWART MITCHELL, *Associate Editor* JOHN C. ROBINSON, *Associate Editor*
HELEN HALSTED, *Assistant Editor*
WILLIAM R. CHANEY, *Chief Photographer*

Editors are invited to use information contained herein and to request prints of any black and white photographs.

Address communications to: EDITOR,
CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

MacArthur Freeway

By J. B. WATSON, Assistant District Engineer and
J. D. COLLINS, District Construction Engineer



Since February, 1960 construction has been underway on MacArthur Freeway, a 15.3 mile section of US 50 (Interstate 5W) between the Bay Bridge Distribution Structure and Route 228 at Castro Valley.

On May 15, 1962, Robert B. Bradford, State Director of Public Works and Chairman of the California Highway Commission and County Supervisor Francis Dunn, Chairman of the Alameda County Highway Advisory Committee, cut the ribbon to open the first 2.6 mile section of the MacArthur Freeway between the distribution structure and Grand Avenue in Oakland.

In a previous issue of CH&PW (March-April 1960), the planning, design and right-of-way aspects of this freeway were discussed and it was revealed that borrow and excavation projects on several contracts in this metropolitan area were to be combined in order to effect an overall savings in the construction of freeway embankments. The extent to which this program has been carried out, to an even greater degree than contemplated, is discussed in the following paragraphs.

Three Contracts

This first section of the MacArthur Freeway opened to the public was the culmination of construction under three contracts at a total cost of approximately $11,596,000. Of the six remaining contracts in the entire freeway, two are now under construction two are included in the current budget and two yet remain to be budgeted.

Contractors for the first three completed units were C. K. Moseman & Son, Guy F. Atkinson and Peter Kiewit Sons Co., respectively.

The first project, from the Bay Bridge Distribution Structure to Market Street, included revisions and additions to the distribution structure construction of on- and off-ramps to the existing MacArthur Boulevard and construction of the freeway to San Pablo Avenue. Major structural work involved the construction of six retaining walls, averaging 15 feet in height and totaling 1,500 feet in length; 1,435 feet of widening and 490 feet of extension to the existing distribution structure; the MacArthur Boulevard Undercrossing and the Adeline Street Undercrossing, consisting of two parallel reinforced concrete box girder bridges approximately 1,100 feet long. A record pour of 740 yards of concrete in 13 hours was made while constructing this bridge.

Complicating the project, all four lanes of heavy traffic on US 50 had to be moved through the construction area, involving five intricate stages of traffic shifts and stage construction to accomplish this.

Demolition Required

One of these stages required the demolition and removal of over 400 feet of the existing distribution structure, and with timing an important factor, the crane and headache ball were at work knocking the bridge



Looking westward over the recently completed portion of the MacArthur Freeway between Grand Avenue and the Distribution Structure. Overcrossing in the foreground is MacArthur Boulevard.



This map shows the current status of construction on the MacArthur Freeway.

wn within five minutes after traffic s routed off the structure.

The MacArthur Boulevard Under-ossing is on a 65° skew from the ual freeway crossing, resulting in an usual structure as indicated in the companying illustrations.

The 145,000 cubic yards of im-rted borrow required for this con-ct was to be obtained at the east rtal site of the third bore of the ldecott Tunnel east of Oakland on ate Route 24. Due to the stage con-uction previously mentioned, all of s borrow was not needed during first stage which was completed ring May 1960. The remainder of borrow was not required until er stages of work beginning in June 61, and continuing, as it developed, il the end of January 1962.

n the meantime, however, the con-ct for the tunnel was awarded ner than expected, and the tunnel ntractor was to excavate and stock-e the borrow since it was necessary have the portal area excavated be-e the material was needed on the



Westbound US 50 traffic is routed over the completed Lake Park overcrossing during construction



Heavy traffic on MacArthur Boulevard in Oakland looking west from the Broadway intersection before completion of the freeway.



MacArthur Freeway in Oakland shortly after its completion. Broadway passes under the freeway by the building with the clock tower.

first MacArthur Freeway contract. Instead of resorting to this stockpiling, however, it was decided that the balance of the imported borrow could be more economically obtained from other sources, and as indicated later in this article, was finally obtained from a state-furnished stockpile on rented property immediately adjacent to the right-of-way.

The State was represented on this job by Resident Engineers William C. Sorlie and J. E. Somerville.

Second Contract Awarded

The second contract to be awarded was for the third unit of freeway from Webster Street to Grand Avenue. Construction started in April 1960 and included 19 retaining walls and six major structures, together with construction of one mile of freeway with ramps and city streets as frontage roads. It also provided for utilization of 350,000 cubic yards of surplus excavation for partial construction of embankments for the second unit between San Pablo Avenue and Webster Street. Most of the surplus was used for this purpose during the earlier stages of the job. The contract for the second unit was well underway by the time the last embankments of the third unit were to be built and the last surplus determined and ready to be moved. Reserving room for this last material would have delayed the second unit so some other solution was desirable. This problem arose at the same time as the stockpile problem of the first contract, therefore the solution to both problems was found in placing the last quantities of surplus in a stockpile on rented property.

Roadway excavation on this contract was moved primarily using a shallow-pit beltloader to bottom dump trucks. Greater hourly production was achieved through this relatively new loading method. In addition, material was loaded into the trucks gradually, almost eliminating the problem of compacted material which makes dumping difficult. Also trucks could be fully loaded, yet have no spillage on the existing MacArthur Boulevard haul route, resulting in much less of a problem in keeping the city streets clean.



Grading operations during the early phases of construction on the freeway.

Six Structures

The six major structures included n this contract were: the Broadway-Richmond Boulevard Undercrossing -(two box girder bridges approxi-nately 1,046 feet long); four struc-ures in the Oakland-Harrison Street nterchange, and the Chetwood Street Overcrossing.

The Harrison Street Undercrossing (off ramp) was subjected to a series of tests by the State before it was used by traffic. These tests were con-lucted to measure the effect of:

1. Live load distribution to interior and exterior girders.
2. Effect of transverse diaphragms on live load distribution.
3. Dead load distribution to inte-rior and exterior girders.

Field testing of this structure was ompleted in December 1960, and lab-ratory model testing concluded in December 1961. The final report is nticipated by late 1962. Resident En-ineer James D. Collins represented ne State on this job.

The second unit of the MacArthur reeway – from Market Street to Webster Street—was the third con-act to be awarded. Peter Kiewit ons Co. started work on this 1.1-ile project on August 8, 1960. The ontract called for the freeway with mps and city streets as frontage oads and foundations for the ramp ructures at the future Grove-Shafter reeway Interchange. Only the foun-dations were placed at this time, in order to allow possible use of the me-dian of the planned Grove-Shafter Freeway by the proposed Bay Area Rapid Transit System.

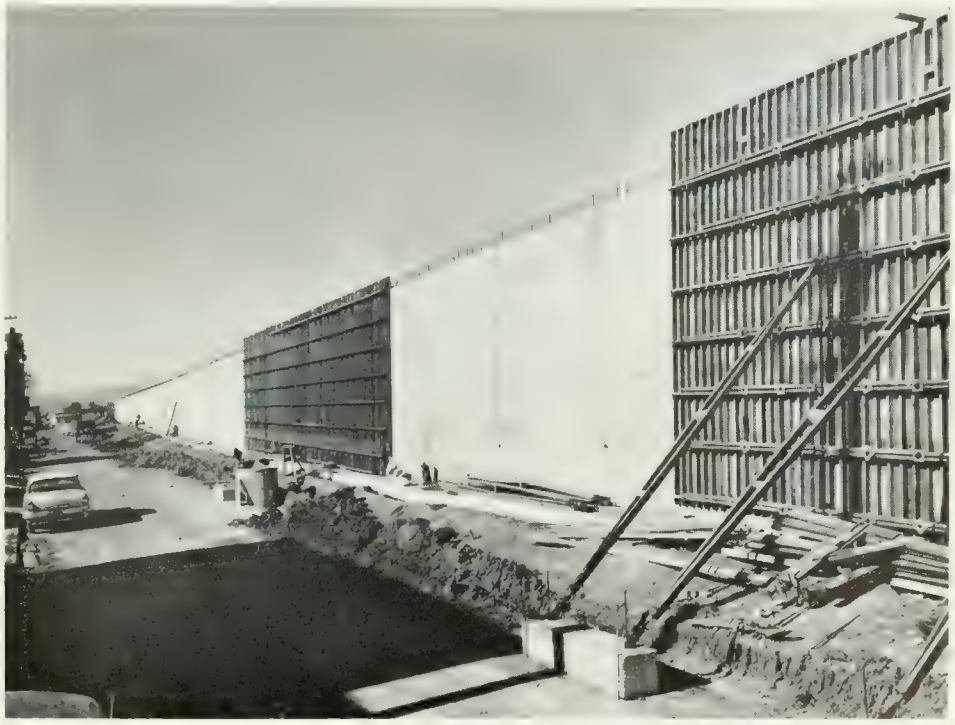
Goes Over City Streets

In this unit, the freeway goes over all city streets and included in the contract were 9 bridges and 11 retaining walls. The construction of retaining walls for the city streets was an extensive project, as indicated by the accompanying photographs. With embankments partially constructed, as noted above, imported borrow from the site of future contracts was used to complete construction of the em-bankments.

One such area was the fourth unit, from Grand Avenue to Park Boule-vard, where a cut on this section was designated as a surplus excavation area and a borrow site of 102,500 cubic yards for use on the second unit. This quantity represented most of the surplus excavation on this fourth unit that was available at this time. Additional borrow was required however, and 125,000 cubic yards were obtained from a cut near the Caldecott Tunnel portal site where borrow previously had been obtained for use on the first unit.

On this job, the State was repre-sented by Resident Engineer William J. Zenoni.

Construction is now underway on the fourth unit of MacArthur Free-way from Grand Avenue to Park Boulevard. This, the fourth contract awarded, is a 1.2-mile project to cost approximately $4,200,000 and to be completed in September 1962.



Retaining wall construction on the freeway in the Market Street area on 35th Street. The view is westward.



MacArthur Freeway construction at the Oakland-Harrison interchange.



MacArthur Freeway construction at the Broadway-Richmond undercrossing.

Retaining Wall Needed

This contract will extend the freeway past Lake Merritt and the Grand Lakeshore area on structure and on sidehill cut and fill to Park Boulevard. This sidehill portion requires a median strip retaining wall 3900 feet long, an 800-foot-long retaining wall on the cut side, and 355 feet of retaining walls on the fill side. There are a total of 11 retaining walls and at one location there are retaining walls at the cut side, in the median and at the toe of the fill.

There are four major vehicular structures and two pedestrian overcrossings. The Lakeshore Park Undercrossing is a reinforced concrete bridge, 838 feet in length and carries the freeway across Grand and Lakeshore Avenues and the Lake Merritt area. The MacArthur Boulevard Overcrossing (Park Boulevard off ramp) is a reinforced concrete box-girder bridge approximately 172 feet long and carries eastbound on-ramp traffic from MacArthur Boulevard over the Park Boulevard off-ramp.

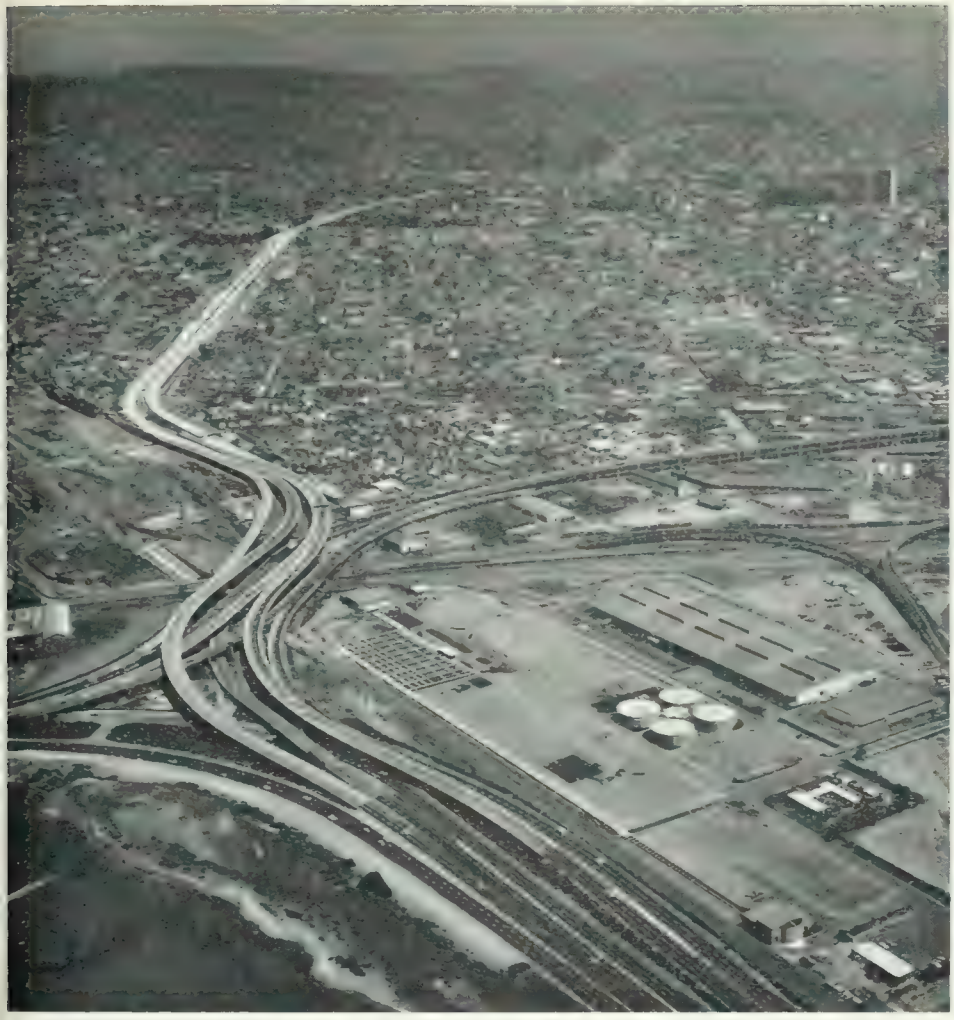
The Lake Park Avenue Overcrossing is a reinforced concrete box-girder bridge about 465 feet long to carry westbound MacArthur Boulevard traffic over the freeway. The Park Boulevard Undercrossing is a reinforced concrete bridge of two parallel spans, 176 feet long, which carries the freeway over Park Boulevard.

The two pedestrian overcrossings are reinforced concrete bridges; 566 feet long at Van Buren Avenue and 382 feet in length at Santa Clara Avenue. These overcrossings will provide for pedestrian traffic from existing MacArthur Boulevard to Santa Clara Avenue in the vicinity of Van Buren Avenue.

Four Stages

The job will be performed in four stages to facilitate handling of traffic through the construction area. This is necessitated by the new freeway alignment which crosses several heavily traveled city streets in the Lake Merritt-Lakeshore Avenue area and the reconstruction of sections of existing MacArthur Boulevard.

As indicated earlier, all of the known surplus material on this project was used on the second unit. It



The MacArthur Freeway through Oakland looking east from the Distribution Structure. The Cypress Street Viaduct on the Nimitz Freeway curves out of the photo to the right.

was later revealed that approximately 25,000 cubic yards was still surplus to this project. In anticipation of this, an area of the future Grove-Shafter Freeway was cleared and this excess material was placed in future fills for this pending freeway.

The State Resident Engineer on this job is W. G. Jue.

The fifth contract of the MacArthur Freeway from Park Boulevard to Buell Street was awarded in August 1961 and work was started on September 5, 1961. The $7,650,000 project will include 16 vehicular structures, a pedestrian overcrossing and a pumping plant, 19 retaining walls and 2.9 miles of eight-lane freeway with appurtenant ramps and frontage roads. Completion date is scheduled for September 1963.

This project also has surplus excavation and this excess will be used in the fills for the future Grove-Shafter Freeway. Since there is a shortage of embankment material for this pending project this disposition of excess provides an economical solution to a vital problem of materials.

On this project the freeway is depressed at several locations and a high ground water level is indicated in the soil borings, thus a major item is the extensive use of underdrains and pervious blankets.

Resident Engineer J. E. Somerville represents the State on this project.

Two More Projects

Two additional projects are budgeted on MacArthur Freeway. Between Buell Street and the east city limits near Durant Avenue, $12,000,000 has been allotted for 4.5 miles of freeway. This project includes the connection to Warren Freeway near Calaveras Avenue where a full directional interchange will be constructed. Modified diamond interchanges will be constructed at five other locations and a total of 12 overcrossings and undercrossings will be built.

South of this project, $4,500,000 is budgeted for 1.9 miles of freeway between the city limits of Oakland and Sybil Avenue in San Leandro. On this unit, a directional type of interchange will be built at the intersection of the existing Foothill Boulevard at the northerly end of the project. Seven undercrossings will be built for city streets and ramps and there will be two bridges constructed over San Leandro Creek for the freeway and a frontage road. Access ramps will be provided at MacArthur Boulevard, Estudillo Street to Grand Avenue between Joaquin and Sybil Avenue and at Benedict Drive.

Funds are also budgeted for two landscaping projects on completed sections of MacArthur Freeway. These include a $170,000 project of landscaping the 2.3-mile section between the distribution structure and Grand Avenue and a similar program between Grand Avenue and Park Boulevard at a cost of $195,000.

With the completion of the various projects of the MacArthur Freeway, US 50 will be full freeway to east of Castro Valley. A major, immediate benefit to motorists will be decreased traffic on Nimitz Freeway as a result of this parallel route.

NEW SAFETY DIRECTOR

Federal Highway Administrator Rex M. Whitton has announced the appointment of James K. Williams, Jr., of Manchester, Connecticut, as Director of the Office of Highway Safety in the U. S. Bureau of Public Roads.

Williams will plan and direct the development of a broad highway safety program throughout the United States. The general objective of the office is to achieve effective use of resources in federal agencies on behalf of safer highway transportation.

Hewes Award

Bridge Department's Roger Sunbury, Lab's Paul Jonas Are 1962 Winners

Roger D. Sunbury, Senior Bridge Engineer, and Paul G. Jonas, Senior Engineer Welding Technologist, are the winners of the 1962 Dr. L. I. Hewes Award, according to an announcement by the Western Association of State Highway Officials. Both men are career employees with the California Division of Highways.

The award, which was established in 1951, honors the memory of Dr. Hewes, the late Western Regional Chief of the U.S. Bureau of Public Roads. It is presented annually for outstanding contributions to western highway development and carries with it a cash prize of $500. The 1962 award was announced on June 13 at the WASHO conference in Seattle.

The team of Sunbury and Jonas received a joint nomination for their contributions to the design and use of high-strength steel in large highway bridges and the development of the arc welding process to a position as an accepted and valuable tool in the structural engineer's field.

Sunbury's work was primarily in the field of the planning and design of structures utilizing high-strength steel members fabricated by welding. Jonas has done outstanding work in advancing and standardizing the technological aspects of welding to make the use of these high-strength steels practical and economical.

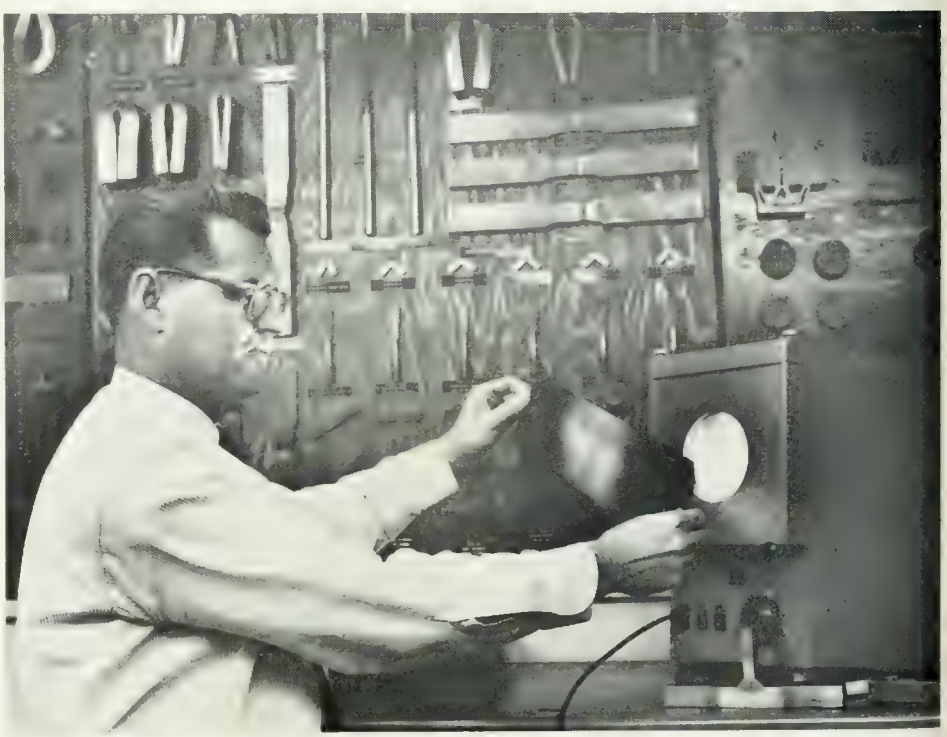
In his letter recommending Sunbury and Jonas for the award, State Highway Engineer J. C. Womack said that it was largely through their efforts that California has been able to establish precedents in the use of high-strength steel in major long-span highway structures, and has, at the same time, been able to confirm welding as the most satisfactory and economical method of fabricating steel members.

Steels Are Combined

According to Womack, steels ranging from ordinary structural steel to the newest high-strength steels have been combined by Sunbury into structures with both marked economy and



Robert L. Byrne, editor of Western Construction Magazine, presents certificates and $250 checks for Dr. L. I. Hewes awards to Paul G. Jonas (center) and Roger D. Sunbury, California Division of Highways Engineer.



Paul Jonas, Senior Engineer Welding Technologist, examines a radiograph of one of the steel plates used in constructing the new span of the Carquinez Bridge. Jonas was responsible for perfecting many of the techniques used in welding together the various types of steel used in the structure.

improved appearance. These new adaptations of different steels are now being duplicated across the country.

The standards for welding procedure and inspection developed by Jonas have been widely adopted by many welding organizations and states, and the California Test Method 601 which he developed is recognized as the best and most comprehensive weld testing procedure available.

To qualify for the Dr. L. I. Hewes Award, a highway engineer must be recommended by the head of one of the 14 state highway departments in WASHO. Persons nominated must be highway engineers of the western states, must have made an outstanding contribution to highway development, and must not be chief engineers or members of the chief engineer's principal staff.

In addition, the engineer nominated must be engaged in planning, design, construction, maintenance, bridge, materials and research, or traffic engineering.

Final selection is made by the Executive Committee of WASHO.

Sunbury and Jonas are the third and fourth California Division of Highways employees to win this award. Previous winners were James T. McWilliam (co-winner—1952) and Arnold H. Carver (winner—1954).

Sunbury Bridge Designer

A native of Ohio, Sunbury graduated from Ohio State University in 1941 with a bachelor's degree in Civil Engineering. He went to work for the American Bridge Company in 1941 and served as an engineering draftsman and field engineer for the company on the Trans-Isthmian Highway in Panama, and on the Alcan Highway in Alaska and Canada. In 1944, he was commissioned as an ensign in the naval reserve and called to active duty in the Pacific.

Upon return to civilian life in 1946, Sunbury was employed as a construction engineer with the American Bridge Company until 1947, when he joined the California Division of Highways. His initial assignments were in construction and estimating, but since 1949, he has been active in the field of bridge design.



An idea of the extensive riveting involved in creating the "lacework" on the older Carquinez Bridge is given in this photo taken during the construction of the new span (in background). The use of welded perforated box girders has virtually eliminated the use of riveting on such structures.



The extensive use of perforated box girders in the new Carquinez Bridge presents a smoother, more eye-pleasing appearance while at the same time making maintenance and inspection faster, easier and more effective.



This view of the twin Carquinez Bridges shows the simple, more eye-pleasing structure made possible by the use of high-strength steels and modern welding techniques. The new structure, on the left, was built at a savings of $800,000 by using these materials and techniques.

Sunbury brought his broad background in engineering to bear on the subject of bridge design at a savings to California taxpayers of more than $1,000,000 to date. Following up his earlier studies on the combining of high-strength steels, he was able to effect a saving of $800,000 by combining three types of steel in a single structure—the Carquinez Bridge. A new high standard for clean, uncluttered truss design was established with the construction of this double cantilever bridge with its all-welded members and bolted joints. Use of high-strength steels allowed slimmer members and afforded great savings of weight in members previously required to be heavy in order to carry large secondary stresses.

Many refinements of design were worked out on the Carquinez Bridge, the Benicia-Martinez Bridge, and the Whiskey Creek Bridge. Different types of steel were successfully combined to save bridge weight and at the same time improve bridge appearance. Plates were butt welded so that higher strength compensated for bolt holes and no increase in section was necessary. Box and H-sections were widely used to simplify the fabrication.

On the Whiskey Creek Bridge Sunbury carried plate girder design to a high degree of perfection by placing the higher strength steels in positions of higher stress, thereby maintaining uniform sections throughout the girder. All of these details are now being widely copied throughout the country.

Jonas Welding Expert

A native of Michigan, Jonas came to California with his family in 1923. He attended grade and high school in Antioch. He then completed a four-year night school vocational trade course in electric arc and oxyacetylene welding, layout, and machine shop practice.

Jonas has completed home study courses and night school courses in advanced welding, in metallurgy, and in teaching. He has had seven years teaching experience at Sacramento City College.

Prior to coming to work for the Division of Highways in 1946, Jonas worked in paper manufacturing, steel milling, ship building and repair, steel fabricating, constructing road building equipment, and inspecting and doing research in welding. From 1944 until 1946 he served with the U. S. Navy in a ship repair unit.

With the California Division of Highways for more than 15 years, Jonas has spent five years with the Headquarters Shops and more than 10 years with the Materials and Research Department. He joined state service as a fusion welder and has served as Assistant Steel Inspector and Associate Steel Inspector. He is at present Senior Welding Technologist.

Starting at a time when structural welding was in its infancy, Jonas developed tests, test methods, and qualification procedures which established welding as a reliable method to be used in many types of structural work.

His California Test Method 601 and his development and interpretation of radiographic inspection results have been widely adopted and copied throughout the country. According to State Highway Engineer J. C. Womack, Jonas' work with the fabricators in developing procedures and inspection techniques and qualifying welders has done much to make welding a practical, dependable, usable shop tool.

Major projects on which he has worked or with which he has been affiliated include the all-welded Skyway in San Francisco, the Oakland Distribution Structure, the Carquinez Bridge, the Benicia-Martinez Bridge, the Whiskey Creek Bridge and the West Branch of the Feather River Bridge.

R.M. Monahan Named B.H.I.F. Executive

Appointment of Robert M. Monahan as executive director of the Better Highways Information Foundation was announced in June by H. D. Anderson, chairman of the BHIF executive committee.

Monahan, who is a former special assistant to the Federal Highway Administrator, succeeds Ellis L. Armstrong, who had been executive head of the foundation since shortly after it was established in 1960.

Armstrong is a former U. S. Commissioner of Public Roads and Chief Highway Engineer of Utah.

Two-Lane Expressways



Good Alignment With Control of Access and Built-in Provision for the Future Serves Present Needs on Many Rural and Mountain Routes

CALIFORNIA's spectacular progress in building multilane freeways and expressways often overshadows the impressive gains which are being made in providing modern two-lane highways to serve motorists in rural and mountain regions.

Obviously, two-lane highways are inadequate to cope with the extremely heavy traffic volumes which develop in metropolitan areas or on major through-routes; but these work-horse highways are still an essential component of California's 16,000-mile State Highway System.

Two-lane highways actually account for about 75% of the total operating state highway mileage. As the state's population and traffic have continued to increase, many of these routes have become overcrowded and in urgent need of widening or upgrading to multilane freeway or expressway standards. These outmoded sections are steadily being eliminated under the state's extensive program of highway improvement.

However, there are many places in California where *modern two-lane highways* will be adequate to handle traffic for a long time. In such areas, it is impractical to build four-lane highways initially; so high-standard two-lane facilities are constructed, with provisions for future widening when required.

An important distinction should be made.

Modern two-lane highways should not be confused with old-fashioned routes which meander through the countryside along ancient wagon roads or stock trails, or around farmsteads, taking motorists over narrow pavements, around hairpin curves, and up steep grades.

Today's two-laners are wider, straighter, and less steep. They present fewer driving hazards and points of traffic conflict. Their design is better oriented to the needs and habits of both local motorists and through travelers.



PHOTO TOP OF PAGE—Scenic two-lane expressway on State Sign Route 36 near Mineral in Tehama County. PHOTO LEFT—On this two-lane expressway section of Sign Route 120 near Oakdale, the old highway (foreground) now serves as a frontage road providing access to farms and homes.



This section of US 50 east of Sacramento, commonly known as the Folsom Bypass, is identified as a two-lane expressway by the rectangular sign on the fence at the extreme right. Inset right is a blow-up of the sign.

There is another important, although not always recognized, difference. Most of the recently-built two-lane highways in California have provision for some measure of access control—that is, regulation or limitation of access to or from adjacent property.

Two-lane highways with access control are frequently referred to as "*two-lane expressway*," or "*two-lane freeways*." California now has more than 600 miles of limited access two-lane expressway in operation. Another 100 miles are under construction or budgeted.

Access Control

California adopted the access control principle in highway design in 1939 when the State Legislature enacted the state's freeway law. This measure introduced the term "freeway" into the statutes. According to the law, a freeway is a highway "in respect to which the owners of abutting lands have no right or easement of access to or from their abutting lands or in respect to which such owners have only limited or restricted right or easement of access."

Thus, in a legal sense, any highway with controlled access is a freeway. This is true whether it has only two lanes or has eight lanes and a dividing strip.

All freeway routes for limited access highways are established by the California Highway Commission, after careful planning by state and local agencies and subject to definite procedures for detailed public discussion, coordination with local master-planning and agreement with local government bodies regarding access provisions and local road adjustments. These procedures, which also apply to "two-lane expressways" as well as to urban multilane freeways, will be discussed later.

While any highway with access control is *legally* a freeway, the term has a more restricted meaning in common usage.

Most people think of a freeway (or a full freeway) as being a divided highway with from four to eight traffic lanes. Vehicles enter or leave this type of highway via interchange or access ramps. Cross traffic is carried over or under the main line. The right of way is fenced and roadside business districts or residential areas are served by frontage roads and special connectors.

Another type of controlled-access highway is the "expressway," which is also a divided highway, usually four lanes. On these routes, some cross traffic and left turns, and sometimes private access, are permitted at certain intersections.

Purpose of Control

The access control concept, which California helped pioneer, is now accepted and endorsed by planners and highway designers throughout the world. Full freeways, or other types of limited access highways, are now planned, under construction or in op-

ration in most countries where people depend on motor vehicles for daily transportation.

The access control design is a proven engineering answer to the problem of keeping heavy traffic on the move, expeditiously and safely.

The traffic benefits of access limitation are best demonstrated in the full freeway design which provides total control of access, thereby erasing many of the dangerous and annoying traffic conflicts so often encountered on conventional routes.

Stop lights and intersection pile-ups are eliminated. Pedestrians are usually prohibited, as are bicycles and scooters. On full freeways there are no vehicles crowding on to the main line at random from roadside businesses and private driveways. There are no sudden stops when the car ahead slows to make a left turn.

Access control also protects the highway investment. Where access is regulated, the safety and traffic capacity of the highway are permanently retained. By contrast, indiscriminate access means that the highway quickly becomes choked and inefficient.

Of course, traffic and economic benefits vary according to the extent of access control. Full control means maximum dividends in safety, convenience and long-term efficiency.

All access-controlled highways are marked with special freeway signs which are placed along the right of way *(see accompanying picture)*. These signs will be found both on heavily traveled freeways and on two-lane expressways.

Two-lane Expressways

Although two-lane expressways closely resemble conventional two-lane highways in many respects, motorists can tell the difference by looking for these freeway signs and for certain characteristic design features.

At some locations, motorists on two-lane expressways will observe that specially constructed road connections and frontage roads are provided to serve adjacent business districts, recreational and camping areas, and other facilities.

At busy intersections, acceleration and deceleration lanes are often provided and left turn lanes are also included. Passing or truck lanes are added as necessary on upgrade sections in mountainous terrain.

Most two-lane expressways will have to be expanded at some future date to meet the demands of increasing population and resulting gains in motor vehicle travel.

When population and traffic estimates point to a probable future need for widening, the Division of Highways purchases enough right of way for this purpose at the time of the initial two-lane construction.

Consequently, there are many two-lane expressways now in operation on established right of way wide enough for four or more lanes and a dividing strip.

This practice of satisfying future right of way needs at the time of initial construction results in substantial savings in right of way costs—especially in rapidly developing areas where land values are increasing and where considerable roadside business and residential construction is going on.

Although the Division of Highways acquires access rights for all two-lane expressways, occasionally these rights are held in reserve, with no special control measures taken at first. In



In winter, snow poles line this two-lane expressway section of US 395 just south of 8,138-foot Conway Summit (background) in Mono County.



sparsely populated sectors or in country where rough terrain restricts access, controls may not be necessary

Freeway-Expressway System

In 1959, the Legislature adopted the California Freeway and Expressway System, a master plan which calls for the construction of a 12,500-mile network of limited access highways by 1980.

This system, adopted after many months of cooperative planning by state, city and county authorities, is expected to carry nearly 60 per cent of the state's total motor vehicle travel in 1980 and connect all cities of more than 5,000 population.

In rural and mountain areas where traffic is relatively light, many of these highways will be built first as two-lane expressways. They will be widened to four or more lanes when necessary in some cases well beyond 1980. Some may not be four-laned for many decades.

Routes in the system have been designated by the Legislature in a general way. Usually only the termini are specified in the statutes.

Selection of the actual location for a route between these termini is the

PHOTO ABOVE LEFT—One of the more heavily traveled two-lane expressways is this section of US 395 north of San Diego. BELOW LEFT—Today's traffic using this two-lane expressway bypass at San Juan Bautista. Right-of-way has already been prepared for widening to handle increased traffic of the future. BELOW RIGHT—An extra uphill lane, guard rail and lined drainage ditch are part of the two-lane expressway construction on Sign Route 1 north of Santa Cru





responsibility of the California Highway Commission, a seven-man body of business and professional men who represent the entire state rather than a particular city or region.

The six non-salaried commissioners are appointed by the Governor for four-year staggered terms. The seventh member of the Commission, and its ex-officio chairman, is the State Director of Public Works.

Freeway Route Selection

All freeway routes for limited access highways, including full freeways and two-lane expressways, are selected according to policies and procedures which have been followed for many years by the Highway Commission and the Division of Highways and which were incorporated into state law in 1961.

The object of these procedures is to insure painstaking study, careful consideration of all data, and complete public discussion of all possible routes. California insists that the people of a community must be informed and consulted early and often about freeway plans.

The procedure for selection of routes for limited access highways is outlined here in brief:

The general termini for a given route are set by the Legislature, often as a result of cooperative studies made by the state and local government.

Before possible routes between these termini are laid out, the Division of Highways consults city or county planners and traffic engineers to determine the area's needs, plans for development, and other factors. Local government agencies are notified that route studies are starting. Frequently, informal public meetings are held to explain problems and obtain preliminary ideas.

Working in close co-operation with local technical staffs, the division conducts extensive traffic, engineering and economic studies. Local master plans are reviewed.

On the basis of these studies, alternate routes are reviewed and evaluated. After careful examination, the division boils down the possibilities to those routes which are considered feasible.



On US Highway 99E through farming country near Chico, Butte County, the unused right-of-way (left of tall utility poles) is held in reserve until four lanes are required to accommodate increased traffic volume. Shown in foreground is part of a four-lane segment at the busy Oroville turn-off intersection.



PHOTO ABOVE—Modern two-lane expressway on Sign Route 49 in the Mother Lode country between Auburn and Grass Valley. There is sufficient area between the right-of-way fences to permit future expansion of this highway when it becomes necessary. PHOTO BELOW—Two-lane expressway on the scenic Luther Pass (Sign Route 89) in Alpine and El Dorado Counties. Modern two-lane highways of this type are offering a more enjoyable ride to motorists in many of the state's scenic and recreational areas.



These alternate routes are then presented formally to the public at a series of map displays, group meetings and hearings. Further study frequently follows.

Upon completion of this additional study, the State Highway Engineer recommends to the Highway Commission the route which offers the best combination of advantages, considering engineering, economic and community values. Information on all other alternates is also presented to the commission.

The Highway Commission itself then takes the matter under consideration. Local governing agencies are notified that if it is considered necessary or desirable, the Commission will hold a public hearing in the area concerned. Even when no hearing is requested, the Commission waits at least 30 days before making a decision. In some cases, when it appears advisable, the Commission will call a public hearing on its own.

After the Commission adopts a route, there is still another step. Under California law, there must be a "freeway agreement" with the local government concerning necessary street and road adjustments and closures.

Freeway agreements for initial two-lane expressways usually cover also the ultimate designs standard—perhaps a four-lane expressway or even a full six or eight-lane freeway with crossing structures and total control of access.

Occasional Misunderstanding

During the course of all the study sessions, group meetings, map displays, and public hearings regarding the establishment of a freeway route for a two-lane expressway, misunderstandings sometimes develop, arising from the double-meaning of the word "freeway," which in a legal sense means any access-controlled highway, but which in common usage refers to a multilane divided highway with interchanges and crossing bridges.



No special access-control measures have been required on this two-lane expressway section on Sign Route 20 in Mendocino County because natural terrain features—the stream and the steep wooded slope—already protect the right-of-way.



OTO ABOVE—Two-lane expressway on US Highway 395 south of Alturas, Modoc County. PHOTO BELOW—This section of US 395 in Lassen County mbles good two-lane highways which have been in operation for a long time. The right-of-way fence gives an indication to the observant motorist that he is traveling on a two-lane expressway where access is regulated.





On two-lane expressways in the mountains, passing lanes are frequently provided on steep grades to alleviate tie-ups occasioned by slow-moving vehicles. Photo shows passing lane on US Highway 40 Alternate in Plumas County.

Superhighway Envisioned

When the term "freeway" is used during two-lane expressway planning sessions, a few individuals immediately envision a big superhighway such as might be required in a metropolitan area or on a heavily traveled through route.

With this picture firmly fixed in their minds, they offer alarmed protests, pointing out that traffic, population density, and the social and economic makeup of the area do not justify superhighway development:—"all we need is a good two-lane highway".

It sometimes takes a great deal of patient explanation and repeated assurances from highway planners to erase this confusion and to convince people that "a good two-lane highway" is exactly what is being contemplated—a highway which will look much like the present two-lane route, except that access will be regulated, and the roadway will be wider with fewer steep grades and sharp curves, and there will be provision for eventual widening when warranted.

Summary

California's population will continue its upward spiral in the coming years.

As the population continues to increase, there will be even greater gains in travel on the state's roads, streets and highways. In 1980, there will be nearly twice as many people in California as there are today; and motor vehicle travel will have *tripled.*

The state is preparing for this future growth, following a Legislature-adopted master plan to construct the "California Freeway and Expressway System".

As work moves along on construction of this limited access highway network, full freeway construction in metropolitan areas and on major through routes will receive the greatest share of publicity and public recognition.

More Recognition Expected

This is to be expected because of the magnitude of such construction the complex problems involved in centers of dense population and heavy traffic, and the enormous motoring and economic benefits which ful freeways provide.

However, important rural highway with smaller traffic volumes will no be neglected.

In the years ahead, many of thes highways in scenic mountain, forest desert and seashore areas and throug agricultural regions will be converte to modern two-lane expressway stand ards—with provision made for futur expansion as required.

These new two-lane highways wil permit safer, faster and more pleasur able travel for the residents of thes areas, as well as for commercial traffi and for visitors on a summer vacatio or a winter ski trip.

Helen Halsted Retires From Information Section

Helen Halsted, Assistant Information Officer for the Division of Highways, will retire August 1, after more than 38 years of service with the division.

Mrs. Halsted came to work for the division in November of 1922, and has worked under all six State Highway Engineers. Her only break in service was one year in 1928-29.

Entering service as a stenographer, she progressed to senior clerk and senior stenographer-clerk before entering the information field in 1952.

She is an avid world traveler and frequently visits her son, Donald E. Halsted, who resides with his wife, Ann, and children, Jill and Mark, in Juneau, Alaska, where he is a bridge engineer for the state highway department.

Moonlight Ride

San Diego 'Crosstown' Is Freeway With View

The following article by Hal D. Steward reprinted from the *San Diego Union*.

If you haven't yet gone for a moonght drive on the new Crosstown reeway, you should.

It's really the "freeway with a ew," the only one like it in Calirnia.

The first two links of the freeway, hich were opened last Friday, take ou from the vicinity of Lindbergh ield to Park Boulevard immediately front of the U.S. Naval Hospital.

A reporter and a photographer ook the "moonlight ride."

Should you take the same ride, you ill enter the north end of the freeay from Palm Street off U.S. 101 ast of Lindbergh Field. You'll travel vo blocks down Palm and turn right n Kettner Boulevard. One block raight ahead is the freeway entry.

Lights of City and Bay

As you come out of the ramp onto he freeway you will see the lights of an Diego to your right with San iego Bay in the background.

The eight-lane, divided freeway kes you across the top of the city. From here you see the lighted ips in the bay, the Lindbergh Field nway lights, the bright blue lights op the Security First National Bank, e San Diego Gas and Electric Co., d tall civic center off to their right.

You will notice as you approach em that each overpass has markers lling you the configuration of the ad ahead. This will help you from tting in the wrong lane and finding urself on or off the freeway when u intended otherwise.

The first off-ramp you will come as you take your drive south is rked Front Street and Second venue.

But before you reach the turnoff u will have noticed the glowing red on lights atop El Cortez Hotel off your left.

Dips Under Overpasses

Once you're past the first off-ramp e freeway takes a dip under over-



The San Diego "Crosstown Freeway" shortly before it was opened to traffic on June 6.

passes. As you come out you'll see an off-ramp marker for downtown. This brings you out at 10th Avenue and Ash Street.

As you approach the 10th and Ash turnoff, the freeway divides—left joins up with U.S. 395 to Escondido; right takes you to 10th Avenue.

When you have reached this point you've covered the new freeway links going south.

But you may have decided to take your drive of the new freeway coming in from the south. To do this you pick it up at 11th Avenue and A Street. Be sure you make your turn into the far right lane. A few hundred yards ahead you'll see an off-ramp to the right marked Los Angeles —this is your ramp. It carries you up, around to the left and over U.S. 395.

You also can enter the northbound on-ramp from Park Boulevard adjacent to the naval hospital.

The first off-ramp you'll come to going north is at Fourth Avenue. The other off-ramps are at Hawthorne and Palm Streets.

Your ride north will end at Olive Street.

Part of Lengthy Route

The 1.7-mile Crosstown Freeway is a section of the San Diego Freeway, which eventually will run from the San Fernando Valley to the Mexican border.

A third unit now under construction will extend the freeway south, including a connection with the State 94 Freeway at 18th Street.

The first two links opened Friday and the third link under construction are the first units of a 12-mile $60 million freeway which will knife through central San Diego and National City.

It will offer the traveler a scenic view all the way since much of it is being built above the city.

The links opened Friday are expected to relieve traffic in downtown San Diego during peak periods. San Diegans who live in the northern part of the city will want to use it to enter and leave the downtown district.

You can enter the freeway from downtown at either First or Fifth Avenues. The Fifth Avenue on-ramp south was not open Sunday, but it appears completed and should open to traffic shortly.

Motorists should experience no difficulty in traveling the Crosstown Freeway or in finding their way on and off it.

'Vigor, Charm, Culture'

During Friday's freeway opening ceremonies, Roger Wooley, State Highway Commissioner from Rancho Santa Fe, said:

"The freeway is indicative of a San Diego which is combining the vigor of Los Angeles with the charm and culture of San Francisco."

The R. E. Hazard Contracting Co. and the W. F. Maxwell Co. built the freeway unit from Palm Street to Sixth Avenue at a cost of $5.2 million. The link from Sixth Avenue to Park Boulevard was built by the Daley Corp. and R. M. Price Construction Co. for $3.4 million.

Two central area streets have been made one way because of the new freeway. Front Street has become one way southbound and First Avenue northbound.

Today will be the first day San Diegans will give the new freeway full use.

So, if you haven't taken mama and the kids for a moonlight ride along the Crosstown Freeway, do it soon.

It will give you a new appreciation of the beauty and progress of your city.

Contracts Awarded on Retirement Building

Four contracts totaling $8,221,016 were awarded on June 25 for general, electrical and mechanical work and elevators for the State Retirement Fund Building, now under construction in Sacramento. Larger than any other state office building in California, the building will be the fourth largest office building west of Chicago. The bid opening date was extended from May 22 to June 19 because labor disputes prevented contractors from estimating labor costs.

TRAFFIC ENGINEERING AWARD PRESENTED TO DIVISION



Presentation of the National Safety Council Certificate of Achievement in Traffic Engineering for 1961 to the State of California took place on June 25, 1962, in the Office of Governor Edmund G. Brown. Taking part in the ceremony before a group of local and regional safety council leaders from all parts of the State were, left to right: G. M. Webb, Traffic Engineer, State Division of Highways; J. C. Womack, State Highway Engineer; Governor Brown; and John G. Hall, Western District Director of the National Safety Council. California has consistently won the plaque for outstanding performance in traffic engineering in recent years, in competition with several other large states in that phase of the annual traffic inventory conducted by the NSC.

National Cooperative Research Program Initiated

The beginning of the multimillion-dollar National Cooperative Highway Research Program (NCHRP) was announced in July by R. R. Bartelsmeyer, Chairman of the Highway Research Board, on behalf of the American Association of State Highway Officials, the Bureau of Public Roads, and the National Academy of Sciences-National Research Council. An agreement among the three organizations was signed June 19; less than a week later, on June 25, the board's NCHRP committee under the chairmanship of T. E. Shelburne held its first meeting in Washington.

The Highway Research Board, which will administer the program, operates within the Academy-Research Council's Division of Engineering and Industrial Research.

About $2,500,000 will be spent on the program during its first year of operation. Future expenditures will depend, in part, on the support received from sponsoring state highway officials.

The six research areas include studies of the extension of the AASHO road test findings; reliability of methods for determination of benefits from highway improvements; techniques for improvement of traffic capacity and safety; beneficiation of poor aggregates and development of new aggregates; freeway lighting, and highway structure protection; and snow and ice control. Other areas of research will be added to this list as the program progresses.

Program activities within the Highway Research Board have been placed under the supervision of M. E. Campbell, a member of the staff since 1945.

Traffic Census

Self-recording Equipment Replaces Manual Counting

By THOMAS N. TAMBURRI, Assistant Traffic Engineer and
CARROLL E. DUNHAM, Associate Highway Engineer

After nearly five decades, manual counting of traffic on the California State Highway System has given way to a new and expanded program of obtaining traffic census with automatic self-recording and mechanized equipment. The old method of counting 16-hour, two-days a year samples in July was replaced by a continuous year-round sampling and estimating procedure. The new method is designed to increase the efficiency of the statewide census count and to obtain a great deal more traffic information without increasing the cost.

The new program, adopted in January 1961, combined the rural and urban count systems into a single composite program replacing the manual counting procedure with a completely mechanized system. It established small full-time census crews to replace the thousands of temporary employees formerly hired to conduct the annual July count. Through a firmer basis of control counting the new program permits 24-hour profile counting to be done thoughout the year.

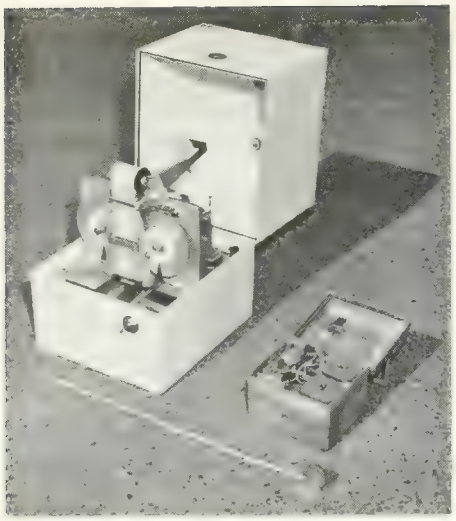
The new program further provides expansion factors (used to convert profile counts to Average Daily Traffic) to be applied by individual route assignment rather than by geographical subdistrict as in the past. The number of control and profile count stations was increased more than three times while the annual cost of the program was reduced to approximately one-half. The net result is that considerably more traffic data (except for classifying trucks) of much greater accuracy is available at approximately one-half the former cost.

The annual Traffic Census Booklet also underwent major revision. The former raw count data (16-hour Sunday and Monday July counts) were replaced with Annual Average Daily Traffic estimates and Peak Seasonal Average Daily Traffic columns. The new booklet utilizes a county-route-postmile system for identifying count locations and an improved list of intersection and landmark names to make the information more meaningful to the public. The detailed average daily traffic profile can now be plotted directly from the booklet. (See page 23).

Control stations are counted for a minimum period of seven days each

PHOTO BELOW—Ultrasonic traffic detectors (on steel girder, top of photo) are mounted over each traffic lane on high-volume, multilane freeways. This installation is on the Bayshore Freeway in Burlingame.





A punch-tape recorder counter (left) and a junior nonrecording traffic counter (right).

month. Profile stations are counted for approximately 24 hours once a year. To compile and publish the census booklet by the end of the calendar year, the count year is from October 1 to September 30.

History

California was among the leaders in initiating a regular system of counting and publishing traffic census data. The following census count table appeared in the "Fourth Biennial Report of the Department of Engineering." (Reproduce Table No. 48, Page 240, of Report.)

Although records of vehicle counts date from 1913, California obtained and published the first regular annual traffic census information in 1924. The first statewide traffic data came from 300 widely dispersed locations. Early day counts were recorded on a clipboard in the field. The counts were converted to average daily traffic by hand calculations in the office. All counts were classified by types of vehicles, including for many years, horse-drawn and foreign vehicles. This early day system was so successful (and checked so closely with the statewide estimate of vehicle miles driven derived independently from annual gasoline sales) that it was maintained with relatively little change through 1960.

Prior to 1936, the statewide vehicle count was made and published semiannually, in mid-January and mid-July. From the midtwenties, the counts were for 16 hours on two consecutive days (from 6 a.m. to 10 p.m. on the Sunday and Monday nearest the middle of the month). This type of sampling proved adequate in many respects. The Sunday-Monday relationship gave a clear indication of the weekend versus weekday traffic, hourly data were available for both days, and ample information was recorded on the various types of vehicles at each count point. From a very early date traffic was counted at highway junctions since a single observer could record traffic on all legs of a rural intersection simultaneously.

Minimum in January

During the period of the semiannual counts, approximate maximum and minimum daily counts were available for analysis. January has consistently remained the month of minimum daily traffic at the vast majority of points on the state highway system; while maximum daily counts are usually recorded in August, with July ranking a close second. (This pattern is usually reversed on the desert highways.) To verify the accuracy of the semiannual system of counting, a monthly count station was established and observed closely at San Lucas on U.S. 101 in Monterey County. Incidentally, this station is still being counted, providing an important link between the various traffic counting systems utilized over the years.

In 1936, the January semiannual count was dropped. At the same time, 37 monthly control stations similar to that at San Lucas were established. Simultaneously, 33 geographic subdistricts were created with their boundaries encompassing areas of common climatic conditions and similar traffic patterns. Each subdistrict was represented by one or more monthly count stations which produced seasonal traffic factors capable of expanding all July counts within the subdistrict to average daily traffic. The monthly count stations provided 16-hour counts on the Monday nearest the middle of each month, except that 24-hour counts were made in July.

Seven-day Stations

A system of seven-day count stations was created in 1934 to verify that the ratio for weighting the July annual counts (one Sunday plus six Mondays divided by seven) was accurate. For many years, small adjustment factors were applied to correct this basic Sunday-Monday relationship where the true weeklong counts were not exactly equal to the sum of six Mondays plus one Sunday count. The seven-day count stations were originally established at the rate of one per district, but this number had grown to

TABLE No. 48.

Traffic Census, State Roads.

Name of road	Year	Automobile number		Team number		Loose stock number	
		Through	Local	Through	Local	Through	Local
Emigrant Gap	1913	2,200		100		440,000	
	1914	4,500		1,100		440,000	
Myers-McKinneys	1913	10					
	1914	3,000		1,000			
Lake Tahoe	1913	2,919					
	1914	4,405					
Alpine:							
Carson Pass	1913	31	44	45	135		
	1914	119		228	200		
Ebbetts Pass	1913	20	70	158			
	1914	750	1,500	343			
Alpine Trunk	1913	192		146	7		
	1914	331					
Alpine, Mono section	1913	60	300	620	45		10,000
	1914	330	1,060	612			
Sonora-Mono	1913	200	50	100	75	90,000	120,000
	1914	500	360	170	612	98,000	123,000
Trinity-Humboldt	1913	200		50			
	1914	670		150			

Table of 1913-1914 traffic census reproduced from the "Fourth Biennial Report of the Department of Engineering." Note the types of vehicles and animals counted.

25 by 1960. They provided 24-hour counts from the Friday preceding the July count through Tuesday following the annual count. Wednesday and Thursday were 16-hour counts adjusted by the 24-hour to 16-hour ratio of Tuesday.

A dozen new monthly count stations were added to the system in 1939, and the number grew steadily thereafter until 1960, when a total of 98 monthly control stations were functioning in 47 geographic subdistricts.

The number of annual count points on state highway legs had grown to 3,250 in 1960. These were generally legs of intersections originating from 1,680 locations on the state highway system. In addition, 900 county road legs were also counted and published with equal billing in the Annual Traffic Count Booklet.

Machine data processing methods to compute annual daily traffic were introduced in 1938. The average daily traffic computed for each section of highway was converted to annual vehicle miles and became the basis for the calculation of accident rates per route segment, per type of highway, per freeway, etc.

Trucks Reclassified

Originally, trucks were classified simply as "light truck" or "heavy truck". Classification by number of axles was initiated in 1945. An independent series of truck factors was determined in 1955, and each year thereafter, so that each group of trucks could be more realistically expanded from raw counts to average daily traffic. These factors were established for pickup, light, and heavy trucks. The classified truck factors were computed at each control station and factors were applied individually to each of the groups. At most locations, the factors for heavy trucks (the 4, 5, and 6-or-more axle group) were found to vary considerably from the total traffic pattern.

In 1957, it became evident that the statewide count system was primarily rural and no longer adequately represented the vehicle miles being driven on state highways in urban areas. (In 1960 there were 18 billion vehicle miles driven on the rural system and 15 billion vehicle miles driven on state highways within cities.)

Only 8 percent of the annual count locations were in cities, whereas almost one-half the travel was on the urban highways. Therefore, a separate "urban count system" was inaugurated in the summer of 1957. That year 24-hour profile counts were made on a weekday on all state routes within cities. Thereafter, counts were made four times a year at selected stations for the purpose of factoring and updating the original profile counts. The large majority of these counts were machine counts, with a few manual classified counts scattered throughout the system. In the next three years, only such new profile count locations as were necessary to keep the urban counts current were added. The urban

Mile Post	Description	Sec.	Seasonal Peak ADT	Annual ADT
0.55	Napa, Soscol Avenue		9,600	8,000
			9,600	8,000
	Napa, Third Street		12,600	10,600
			11,600	9,800
	Napa, Lincoln Avenue		8,400	7,100	
			5,800	4,900
	Road (Rte. 6 Spur)	A	7,800	4,700
	Peak Road	A	5,800	3,500
			5,800	3,500
	2.2 Mi. North of Trancas Road	A	1,800	*1,100
			1,800	*1,100
	Wooden Valley Road	B	1,400	870
			1,500	920
	Jct. Rte. 102 (Sign Rte. 128)	B	1,600	940
			280	170
20.45	Napa—Yolo County Line	C	580	350
	DISTRICT III			
0.00	Napa—Solano County Line	B	580	350
0.75 =0.00	Solano—Yolo County Line			
			650	480
	County Road 86	D	1,200	870
	County Road 87V	D	1,200	870
	County Road 87E	D	2,100	1,500
			2,100	1,500
	Winters, Railroad Street		4,200	3,000
			3,700	2,700
10.13	Jct. Rte. 80 (Interstate 5W) Final Constructed Route	D	3,200	2,400
	DISTRICT X			
0.75	Jct. Rte. 7 (U.S. 40) Begin Constructed Route	A	24,900	*19,000
2.29	Solano—Yolo County Line	A		
	DISTRICT III			
20.73	Solano—Yolo County Line, Begin Freeway	E	24,200	18,400
20.76	Richards Boulevard Interchange (Access Road to Davis)	E	25,700	19,600
21.22	Liberty Island Interchange	A	29,800	22,700
23.31	County Road 105	A		
24.18	End Freeway		31,900	24,300
26.33	Yolo Causeway	B	31,900	24,300
27.71	Yolo Causeway Interchange, West Capitol Avenue	C		

Mile Post	Description	Sec.	Seasonal Peak ADT	Annual ADT
29.71	Yolo Causeway Interchange, West Capitol Avenue	C		
			26,200	20,000
31.29	Harbor Boulevard Interchange	C		
			18,800	17,500
32.77	Jct. Rte. 99, Jefferson Boulevard Interchange	C		
			28,600	26,600
33.05	Riske Lane Interchange	C		
			32,500	30,200
33.43	Third Street Interchange	C		
33.61	Yolo—Sacramento County Line, Sacramento River Bridge		42,600	39,600
0.00				
0.17	Sacramento, Front Street			
0.25	Sacramento, Jct. Rte. 70 S.C. Inbound (Sign Rte. 24) Third Street & Capitol Avenue		43,700	40,600
			43,700	40,600
0.40	Sacramento, Jct. Rte. 50 Northbound (Sign Rte. 24) Fifth Street & Capitol Avenue		16,600	15,400
			16,600	15,400
0.83	Sacramento, Seventh Street & Capitol Avenue		7,700	7,200
			7,700	7,200
			13,300	12,400
0.88	Sacramento, 10th & N Street		13,300	12,400
1.24	Sacramento, Jct. Rte. 4 Southbound (U.S. 99W) 15th & N Street		13,400	12,400
			8,500	7,900
1.62	Sacramento, Jct. Rte. 4 Northbound (U.S. 99W) 16th & N Streets			

ROUTE 7. ROUTE 69 IN ALBANY TO ROUTE 3 AT RED BLUFF

	DISTRICT IV			
0.00	Albany, Jct. Rte. 69 (US 40)			
			76,000	58,000
0.21	Albany, Pierce Street Ramps			
0.71 =0.00	Alameda—Contra Costa County Line		78,000	60,000
0.22	Richmond, Central Avenue Interchange			
			76,000	58,000
1.00	Richmond, Carlson Boulevard Interchange			
			76,000	58,000
1.07	El Cerrito, Potero Avenue Interchange			
2.04	Richmond, Cutting Boulevard Interchange		68,000	52,000
			78,000	60,000
2.62	Richmond, Macdonald Avenue Ramp			
			76,000	58,000
2.98	Richmond, San Pablo Avenue Interchange			
			76,000	58,000
3.41	Richmond, Solano Avenue Ramps			
			70,000	54,000
3.80	Richmond, McBride Avenue Ramp			
			72,000	55,000
4.14	San Pablo, San Pablo Dam Road Interchange			

A page from the latest annual traffic census booklet showing the new format.

system proved very practical and efficient, but it was supplementary to the rural count system. It became increasingly difficult to integrate the two separate systems due to the nonclassified machine counting and the scarcity of control counts in the urban system.

New Program

A major investigation and evaluation of the count programs was undertaken in 1959 by the headquarters traffic department in co-operation with the district traffic engineers, headquarters planning survey and the U.S. Bureau of Public Roads. It was decided to abandon the then existing rural and urban count programs for a new and integrated system which would equal or improve the accuracy of the old systems and which would substantially reduce cost.

The objectives of a traffic census program are:

1. To provide an estimate of annual average daily traffic at all points on the system. This estimate is used to estimate the total traffic that is carried on the state highway system, to keep track of changes in the amount of statewide travel and changes in travel patterns, and to compute accident rates.

2. To provide an indication of hourly and seasonal variations in flow.

The districts co-operated with the Headquarters Traffic Department in planning and designing the new census program. The program as adopted is hereafter described in its various component parts.

Control Counting

After studying the mass of seasonal data accumulated at the old monthly control stations in recent years and bearing in mind the approximate average daily traffic and vehicle miles driven on each rural section and on each city route, a system of 355 well-dispersed control stations was selected. Route segments having similar traffic patterns were assigned to a nearby control station having the same (or nearly the same) pattern. The limits of each control station's sphere of influence were pinpointed on as realistic a basis as possible, usually at major traffic profile breaks. Artificial boundaries such as city limits and county lines were disregarded.

On a statewide average, each control station represents about 40 miles of highway. However, this varies considerably and according to the relative stability and similarity of individual traffic patterns. For example, in large metropolitan areas, seasonal, daily, and hourly patterns are relatively flat and are stabilized by a predominance of commuter traffic. Therefore, in a metropolitan area there is much less likelihood of making an inaccurate route assignment than in a remote rural area where recreational traffic predominates.

A period of one week per month was chosen as the optimum count period at the control stations. This was done to record traffic in its minimum practical cycle, to allow maximum flexibility to counter crews, and to permit the use of portable equipment. (No attempt is made to count exactly seven days, however. The count period varies from seven to ten days and the individual 168 hours in the week are computed electronically from the available data by averaging

STATE OF CALIFORNIA
DEPARTMENT OF ENGINEERING
CALIFORNIA HIGHWAY COMMISSION

TRAFFIC RECORD

191

OBSERVING STATION NO.....
DATE.....
LOCATION OF STATION ..
Div. ,County ,Route ,Sec ,Sta
SIGNATURE OF OBSERVER

KIND OF VEHICLE		7 A.M. TO 9 A.M.	9 A.M TO 11 A.M.	11 A.M TO 1 P.M.	1 P.M. TO 3 P.M.	3 P.M TO 5 P.M.	5 P.M. TO 7 P.M.	7 P.M TO 9 P.M.	TOTALS
SINGLE HORSE	LIGHT VEHICLE								
	HEAVY VEHICLE								
TWO OR MORE HORSES	LIGHT VEHICLE								
	HEAVY VEHICLE								
AUTOMOBILE	RUNABOUT								
	TOURING CAR								
	MOTOR TRUCKS								
	MOTOR-CYCLES								
TOTALS									
WEATHER CONDITIONS									

OBSERVER WILL NOT WRITE IN THIS SPACE

Count chart used by recorders for the 1913 traffic census. (See instructions, next page.)

uplicate hours.) The same week is ounted each month at an individual ontrol station, so certain stations ould be counted the first week, anther group of control stations the econd week, etc. This method perits the reuse of each automatically ecording count two or three times er month. No counts are scheduled the last week of a month. This peod is set aside for makeup counts in ase of road tube failures or mechanil malfunctions.

Satellite Counting

Satellite (profile) counts were sected at all points of significant traffc breaks along the route. Distances between satellite count points vary from every street intersection or freeway interchange in urban areas to 10 or more miles in remote rural areas. The distance depends entirely on the magnitude and percentage of traffic entering and leaving the highway. There are approximately 12,000 satellite count stations or an average of about one per mile of state highway.

All satellites fall within a predetermined sphere of influence of a control station and are assigned to that control station. It is, therefore, a basic assumption that the hourly, daily and seasonal traffic fluctuations are identical (or nearly so) at each satellite station and at its control station. The patterns may differ only in magnitude (i.e., traffic volume).

Satellite counts are made annually for approximately 24-hour duration, during one of the times the related control station is in operation. The one-day count at the satellite bears the same relationship to the ADT at that point as the simultaneous count at the control station bears to its ADT, hence the name "satellite" or associated station. No attempt is made to count for a period of exactly 24 hours. Instead, the count at the satellite for any convenient period of approximately 24 hours is compared to the count at its associated control station for the identical period.

These counts may be made on any day during the year. Thus, the scheduling of the counts provides maximum efficiency in manpower with a minimum of equipment. As a practical matter, however, it is desirable to avoid counting on weekends and in the winter months when traffic patterns may be erratic. It is also desirable to count as many adjacent profile points along a route on the same day as possible.

On high volume urban freeways where mainline satellite counts cannot be obtained with conventional equipment, all entrance and exit ramps are counted instead and the mainline volumes are computed. However, frequent mainline counts are made and any discrepancies between computed volumes and counted volumes are corrected and balanced.

Future Truck Counts

The truck profile established during the year of 1960 is being used through the calendar years of 1961 and 1962 without benefit of additional classified counts. A study is now being made to determine the necessary interval and frequency of future truck counts. Since truck traffic, both total and by number of axles, is usually fairly stable and changes relatively slowly, classified truck counts can be obtained at considerably less frequent intervals of time and distance.

Equipment

A comprehensive examination of traffic counter equipment in use by other states and experimental work

Instructions to Observers

1. Examine carefully the card marked "Sample," sent to you with the cards upon which you are to keep your records, and be sure that you understand the method of keeping the tally.

2. Your duties begin promptly at 7 o'clock in the morning and end at 9 o'clock in the evening for the seven days shown on the cards furnished to you.

3. In recording vehicles which pass your station, make a mark in the proper column and on the proper line for every vehicle of the kinds called for on the cards, but do not record bicycles or pedestrians. Make an entry for every vehicle, no matter in which direction it is going or whether it has passed you previously. Entries may be made with a lead pencil.

4. **"Light Vehicle"** means a buggy, democrat wagon, or any vehicle other than an automobile, which is used usually for pleasure or light business purposes.

"Heavy Vehicle" means a farm wagon, milk wagon, dump wagon, grocery or provision wagon or any vehicle except an automobile, which is used for carrying heavy loads.

"Runabout" means an automobile built to carry but two people.

5. After you have recorded all of the vehicles during the period from 7 a.m. to 9 p.m., add your tally marks, and place the totals at the right of the card and at the bottom of the card in the spaces provided.

6. When you are sure the totals are added correctly, enclose the card for the day, after you have signed it, in one of the stamped addressed envelopes furnished to you and mail it at once.

7. Be sure that you use the right card each day (look at the date at the top of the card), and do not fail to record every vehicle, called for by the card, which passes your station.

8. If there is anything which you do not understand about the cards or these instructions, write at once to the division engineer, to whom you are to send the cards.

The instruction sheet accompanied the count chart (previous page). A glance of the text shows that problems of vehicle identification have changed somewhat in 50 years.



A typical control station setout on a four-lane divided highway.

done at the Materials and Research Laboratory resulted in a choice of the best equipment available consistent with the needs of the new program.

A new type of hourly recording counter was chosen to record traffic at the control stations. This counter is comparatively light (40 pounds), is powered by a long-life dry cell battery, and produces counts on a punched paper tape capable of being translated automatically and electronically to punched cards. The counter is capable of recording electric impulses from a variety of detectors under study as well as air impulses from a conventional road tube. A total of 264 of these portable counters were acquired to serve the majority of the control stations.

Special equipment was needed at eight control stations on very high volume multilane freeways where it was impractical to use road tubes. Thirty-two dual-lane ultrasonic detectors were installed on overhead mountings to count 60 lanes of traffic. Thirty-two AC powered recording and nonportable counts were added to record data.

A diaphragm operated nonrecording ("Junior") counter was chosen to count at the satellite stations for three reasons: 1. It was already in widespread use by the districts. 2. As the result of an employee suggestion early last year, its performance was substantially improved by the addition of an inexpensive transistorized circuit. 3. The Junior is a lightweight counter powered with two 6-volt lantern batteries.

Transistorizing the Junior counter improved its accuracy, eliminated a tendency of contact points to corrode and stick, and simplified the adjustment for varied impulses. The State purchased an additional 320 Junior counters to handle all satellite counting in the new program.

Twelve trucks were provided by the Equipment Department for the exclusive use of the counter crews.

Seven of the trucks were of the step-in van type, designed to provide space for 20 or more recording counters and allied equipment. Space and tools are also available for field maintenance of the counters. Districts which chose this vehicle have their counter crews in the field for several days at a time.

Five of the trucks were the large station wagon type. These trucks are more maneuverable, but carry only half as many counters and provide little work space. Districts which chose this vehicle have their crews work out of the District Office daily. In addition, five station wagons already in use as counter vehicles were carried over into the new program.

Maintenance Shops

In each district, adequate counter maintenance shops were set up or expanded if already in existence.

An automatic tape translator, complete with a dial-in time-date unit, was installed at Headquarters Office to decode traffic count tapes from the recorders. This translator converts the hourly data on the punched paper tapes directly to punched cards for tabulation and for various calculations.

Except for the few ultrasonic detectors mentioned above, all other counts are obtained from road tubes. The road tube method of detection is far from new and the majority of lost counts are due to hose failures. In the past all road tubes have been of the conventional round hose, but in recent months a new type semicircular hose with a flat bottom has come into widespread use. With some minor exceptions, the flat tube is performing more reliably.

The Materials and Research Laboratory has tested a large variety of traffic detecting devices during the past year, including infrared, ultrasonic radar, ribbon switch tapes, electric magnetic, and various air hoses. One or more of the devices now under consideration may eventually prove more efficient than road tubes. However, the road tube is versatile, easily handled and installed, and inexpensive to replace.

Cost of Program

The cost of the first full year o operation of the new census program was $394,000, a 40 percent reduction from the $658,000 cost of the 196 statewide manual count. A major goa in the design of the new program wa thus attained.

A substantial reduction in cost ha been a primary objective as the four year (1957-1960) average annual cos ($642,000) was considered high, an expansion and improvement of the ol system would have been prohibitive



This two-unit automatic traffic tape translator is connected to the keypunch machine in the background. It transfers the hourly data to punched cards for machine listing and further processing.

Headquarters administrative and tabulating costs were not included in these comparisons. However, they are common to both past and present programs.

The cost of new equipment, including installation where required, was $270,000. When amortized over a 10-or-more-year period this cost becomes nominal. Nonetheless, it was approximately paid for by the first year's savings in operational cost. The savings in cost brought about by the shift to the new program are largely the result of the more efficient operation made possible by the modern automatic equipment.

A total of 6,194 temporary employees were hired to conduct the 1960 annual July count. An additional number of temporary employees (average 389) were hired in every month except July to conduct the monthly counts. The number of full-time Traffic Department personnel needed to conduct the 1961 mechanized traffic census program was 40 (28 field, 12 office).

A comparison in manpower between the 1960 (manual) census and the 1961 census is shown in the following table.

	Man-hours	
	1960	*1961*
Permanent employees	71,131	80,337
Temporary employees	133,961	
Total	205,092	80,337

First Year Operation

Field crews, who began the year inexperienced and generally unfamiliar with the equipment, developed quickly into efficient countermen. These men did an excellent job of obtaining the counts accurately and on schedule. They developed a number of practices and count-saving devices which contributed materially to the success of the program.

The new recording counters were occasionally troublesome, but increasing familiarization by the counter maintenance men and service under the company guarantee held these difficulties within an acceptable range. The statewide average for obtaining uninterrupted control counts (seven or more consecutive days) was 87 percent for 1961. Most of the 13 percent imperfect counts resulted in only a few hours lost data. The number of actual lost counts or unusable counts was under 5 percent. Of the troubles which did occur, hose failures accounted for 50 percent; counter malfunctions (usually related to the clock microswitch and reset mechanisms) accounted for 40 percent; and the remaining 10 percent were due to vandalism and other miscellaneous causes. For the first five months of 1962, imperfect counts amounted to 11 percent of the total.

Circuitry Altered

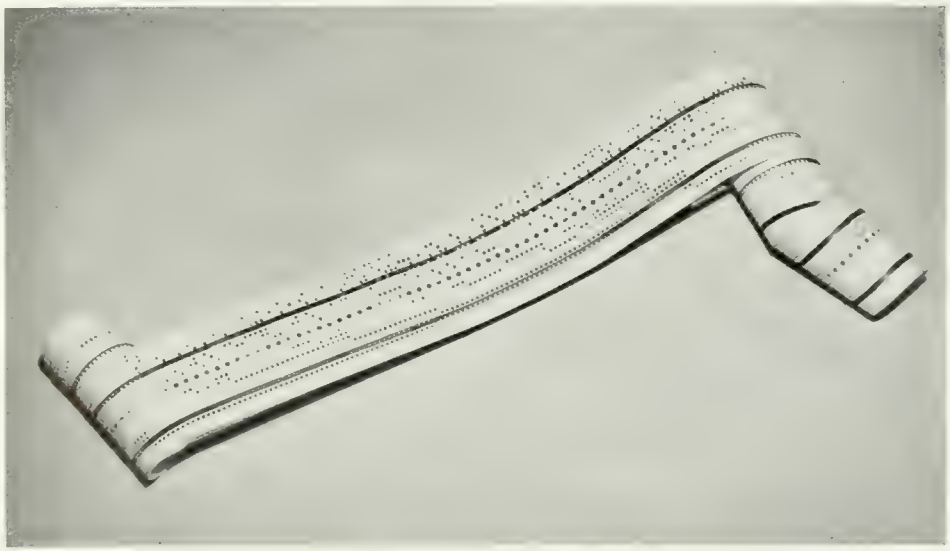
The ultrasonic detectors gave considerable difficulty through the first year. The manufacturer found it necessary to alter the interior circuitry and make several modifications before producing consistently accurate counts.

The transistorized nonrecorder counters were virtually trouble free and produce a high percentage of perfect satellite count data.

Districts Code Data

The district traffic departments shouldered a major but diminishing job of coding the data for machine

. . . Continued on page 28



Your car may have helped make one of the punched patterns on this week-long traffic tape. A tape with hourly readings such as this can be decoded automatically in less than a minute.

Tolls Adopted for New State Bridges

The California Toll Bridge Authority adopted toll schedules for the Benicia-Martinez and San Pedro-Terminal Island Bridges and authorized the Department of Public Works to continue its studies of a proposed crossing between San Diego and Coronado at its meeting in Sacramento on July 19.

The Benicia-Martinez Bridge will be opened to traffic on or about September 15. Its rates were set the same as those in effect on the Carquinez Bridge which runs roughly parallel to it, approximately 5.5 miles west. The single-trip toll for passenger cars will be 25 cents.

The Vincent Thomas (San Pedro-Terminal Island) Bridge will not open to traffic until the end of 1963. However, it was necessary to adopt toll rates at this time to incorporate them into the toll collection equipment now being manufactured.

The adopted toll schedule calls for slightly lesser charges to trucks and buses than on the Carquinez span, but with the same toll (25 cents) for automobiles. It is expected that the traffic induced by these rates will pay off revenue bonds sold for the bridge's construction in 20 years, one-half the time before the bonds become due.

The Division of Highways made preliminary location, traffic and revenue studies to determine the feasibility of a highway toll crossing between San Diego and Coronado under legislation enacted in 1961. Director of Public Works Robert B. Bradford conducted a public explanation and discussion meeting in Coronado on June 6. The report submitted to the Toll Bridge Authority on July 19 stated that four four-lane bridge and five two-lane tube routes were practical. It asked for continuing time to study the effects of the proposed crossings on community values, highway user benefits and city street traffic.

The authority granted this request and called for a final report by September 1962.

In addition to Governor Edmund G. Brown, ex officio chairman, the members of the Toll Bridge Authority are Lieutenant Governor Glenn M. Anderson, State Director of Finance Hale Champion, State Director of Public Works Robert B. Bradford, and James F. Thacher of San Francisco, public member.



A counterman sets out a junior counter at a satellite station. One of the specially equipped step-in van counter trucks is parked beside him.

Traffic Census

Continued from page 27 . . .

processing, identifying and transmitting punched tapes (totaling 500 per month), estimating hourly counts in tape gaps, and editing tabulations.

Programs Tested

The machine processing of the data was the responsibility of Headquarters Planning Survey. Twelve separate machine data processing programs had to be written, tested and "debugged." This proved to be a tremendous task. All data were tabulated by hour and by month. Average daily traffic was computed for each month and for the year, satellite raw counts had to be expanded from satellite-control ratios, and all raw counts adjusted for multiple axle vehicle overcounting and for undercounting due to various factors. Unexpected difficulties in perfecting the machine programs delayed the publishing of the 1961 census. However, now that the programs are available, no delays are expected in the future.

Although many refinements still remain to be worked out, it is the consensus that the new mechanized traffic census program has proven itself in its first full year of operation.

CONSERVATION CENTER

The Division of Architecture advertised in June for the construction of an 80-man branch conservation center near Bishop to be known as the Mono-Inyo Conservation Facility. The center will be operated by the Department of Corrections in conjunction with the Division of Forestry as part of the camp conservation program for the rehabilitation of prison inmates and the conservation of the State's natural resources.

Central Mix

Revised Method Speeds Road Paving Operations

By J. O. KAPONO, Assistant Highway Engineer



The central mixed method of hauling concrete to the job site for paving operations is not new in the field of highway construction, but the practice had until recently fallen into disuse in the west, partly because of segregation taking place in the bed of the hauling unit and partly because of setting of the concrete owing to delays in the paving train. Hence standard paving operations up to this time have necessarily included on-site mixing, mixers, water trucks and batch trucks queued up on the grade.

The current revival of central mix and hauling by specially designed non-agitated trucks by the contracting firm of Peter Kiewit Sons on a District VII freeway construction project heralds new economy and efficiency of paving methods in freeway construction in this area.

First use of central mix was made on the San Diego Freeway project in the Carson-Dominguez area of Los Angeles, between Carson and 190th Streets, a three-mile, $8,120,000 project scheduled for opening to traffic in early August, 1962. (See *San Diego Freeway*, by James E. Martin, *California Highways and Public Works*, January-February 1962). Forty thousand cubic yards of concrete were placed by the same contractor in eight- and nine-inch pavements on this job and 55,000 cubic yards on a separate adjoining contract on the Harbor Freeway.

PHOTO BELOW—The paving train in operation. In the foreground the hauling unit dumps into the spreader box. It is followed by the spreader and finishing equipment.



Concrete Plant

The central mixed concrete plant, erected by the contractor in conven-



The San Diego Freeway with the Carson Street interchange in the foreground. The view is southward.

ient proximity to the construction site, was equipped with 100-cubic-yard capacity aggregate bins; a nine-cubic-yard aggregate weigh hopper; a tilt-drum type 8.25-cubic-yard mixer; a 750-barrel cement silo with 6,000-pound weigh hopper; and a 330-gallon metered water tank.

The control panel was located on a platform adjacent to the mixer and had two separate formulas of accumulated weight devices, whereby two different size batches could be placed on the panel and controlled by a two-position selector switch. The water, air entraining agent, cement, and mixing time were also controlled on this panel.

Coarse, Fine Aggregates

All of the coarse and fine aggregates were trucked in on bottom-dumps. The material was dumped into a hopper through a grizzly. Below the hopper a belt installed on a radial stacker conveyor delivered the material into separate stockpiles, separated by bulkheads. From these stockpiles front-end loaders were used to charge hoppers that were installed for each size aggregate. Under the hoppers a fixed conveyor belt was used to deliver the material to the storage bins above the aggregate weigh hopper.

The cement was also trucked in bulk form. It was discharged into a hopper and transferred into the silo by means of a vertical screw conveyor, the capacity of which was 600 pounds per hour.

The aggregates were then weighed and dropped on a 54-inch conveyor belt approximately 57 feet in length. This belt was installed on an approximate grade of plus 18 degrees and had a capacity of 2,600 tons per hour. The aggregates were then chuted into the mixer.

The moment the aggregates entered the mixer, there was an approximate delay of two to three seconds before the water, cement and air entraining agent entered. The discharge of the water, air entrainment and cement into the mixer was completed before all of the aggregates had entered the mixer. The plant was semiautomatic and fully interlocked.

Mixing

Actual mixing time started after all the ingredients had entered the mixer. As soon as all the scales read zero, and during the mixing, another batch was weighed. The time required to weigh out a complete batch and charge the mixer was approximately 35 to 40 seconds.

A push-button switch was used to tilt the mixer, causing it to discharge. To return the mixer to its mixing position, another push-button switch was used. On the return switch was a timing device that started the cycle of charging the mixer and weighing out the next batch. The total time consumed for a complete cycle was approximately 85 to 90 seconds.

Hauling and Paving

The dump truck body used in hauling the mixed material had all edges and corners rounded and was fitted with a watertight tail gate. It was designed to elevate to a sufficient height for self-cleaning and minimum segregation during dumping.

The mixed concrete was hauled to the grade and dumped into spreader boxes which sized the material into windrows. Then the material was internally vibrated, spread and struck off to the required width and depth by a paddle-type spreader without any segregation of the mix or excessive variation in the amount of concrete placed. A finishing machine screeded off the concrete to grade. Following this was a float for final finishing.

Tamping Bar Used

This float was equipped with a positive action tamping bar installed behind the oscillating screeds, and made as many passes as necessary—two, normally—to produce an even grade. Attached to the back end of the float was a plane or straight edge, on a 28-foot frame. The plane rested on the

PHOTO ABOVE—The radial stacker conveyor stockpiles raw aggregates.

PHOTO BELOW—Central mixed concrete from the nonagitating hauling unit is spread into special contractor-built spreading boxes.

concrete by means of sleds installed on the front and back of the frame. Each sled, made of sheet metal, was approximately 30 inches long and 23 feet wide. In the middle of the plane two adjustable rigid screeds were attached to the frame. On the first pass the concrete was screeded again and the plane lowered so that it rested on the concrete.

The primary purpose of the plane was to cut off any bumps caused by the screeds or any variations in the grade caused by the side forms. The front rigid screed on the plane cut off the bump and the back screed sealed it off.

Concluding this operation, a burlap was dragged over the concrete for texture. The concrete was then edged along the side forms and the burlap was dragged again.

Summary

In summary, the central mix method simplifies paving operations by centralizing the concrete mixing at a single location near the job and by providing for the hauling of the ready-mixed material to the grade by means of nonagitated dump trucks for immediate spreading. A further improvement based on an experimental section on the San Diego Freeway was put to use on the Harbor Freeway project between 208th Street and Pacific Coast Highway. As in slip-form paving, the cement treated base was placed in advance of header installation. On the Harbor Freeway project, this allowed the placement of one mile of 24-foot width pavement in a single day's operation, reducing the number of headers normally needed, and the labor force employed to right headers dislodged by cement treated equipment.

Central mix eliminates mixer and water trucks on the grade, combining batching and mixing into one off-the-job operation. It also lends itself to better dust control and greater safety.



The chain belt at the central mix concrete plant is shown discharging into a nonagitating hauling unit.



A closeup of the chain belt showing the proportional aggregate conveyor (foreground) and the operator's platform and control panel with main mixing drum (left).

Carquinez Traffic Reaches New High

The summer buildup of traffic on the Carquinez Bridge began to be evident in June. A new record total was reached on June 17 when 64,325 vehicles crossed the parallel structures, the most for a single day since the toll project was opened in November, 1958. The previous day's high was 62,804 vehicles on September 2, 1961.

Final Route Link

316-Mile Westside Freeway Now Located

At its June meeting, the California Highway Commission completed route adoption procedure for the 316-mile Westside Freeway (Interstate 5 and 5 E) which will extend from Wheeler Ridge south of Bakersfield to Woodland. It is the longest stretch of Interstate Highway on new location planned in California.

The final link in the long route is in Sacramento, between 0.8 mile south of Freeport and 0.5 mile south of Broadway. Final route adoption was preceded by a commission public hearing in addition to that held by the Division of Highways.

Altogether in its May and June meetings the commission adopted routes for 147 miles of freeway in 14 separate actions, six of which were predicated on public hearings held by the commission itself.

In two instances the commission adopted routes differing in part from those recommended by State Highway Engineer J. C. Womack. These were on U.S. Highway 101 in and near King City and for the East-West (Foothill) Freeway in Pasadena.

In the King City adoption the commission by a four to three vote in effect reaffirmed an earlier route adoption preferred by the community, which opposed a recommended route farther from the business district. In Pasadena the commission brought the route closer into line with a route desired by the city. The commission had held public hearings on both these matters.

Commission public hearings also preceded adoption of routes for the relocation of 18 miles of Sign Route 120 in Tuolumne County; for six miles of Sign Route 29 in Lake County and for sections of Sign Routes 37 and 12 in Sonoma County. The commission followed the recommendation of the State Highway Engineer in regard to these.

Other Freeway Route Adoptions

Los Angeles County—for a revision of an earlier adopted routing for nine-

"ATMOSPHERE OF MUTUAL RESPECT"

(From "Editor's Diary" column by Lee Merriman, Pasadena *Star-News*, June 21, 1962)

If Pasadena came out well in final adoption of the East-West (Foothill) freeway route, and I'm certain it did, this was the result of forthright marshaling of fact, plus mutual respect.

At one time Pasadena and the State Division of Highways were in conflict over the "minor" sum of 7.5 million dollars. The state couldn't squander gasoline tax funds. The federal government, with 93 percent in the kitty, wouldn't go for it. And Pasadena, for the moment at least, would take nothing less.

Yet nobody reared up calling the other nasty names.

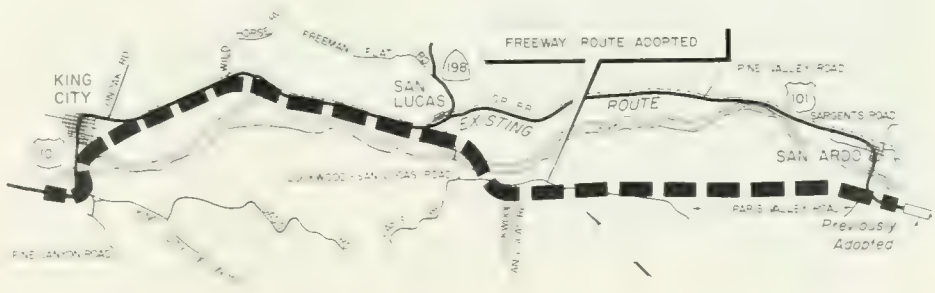
This complete lack of bitterness, this mutual integrity in exploring the deadlock, was largely a new experience for Division of Highways engineers, who are not unaccustomed to abuse; and for members of the State Highway Commission, whose Glendale, Sacramento, San Francisco and now Long Beach hearings have been marred by tirades.

In any such protracted discussion as marked location of our freeway, each side at the outset takes a negotiating position. You ask for much more than you expect to get. The other side offers much less than it thinks it will end up giving.

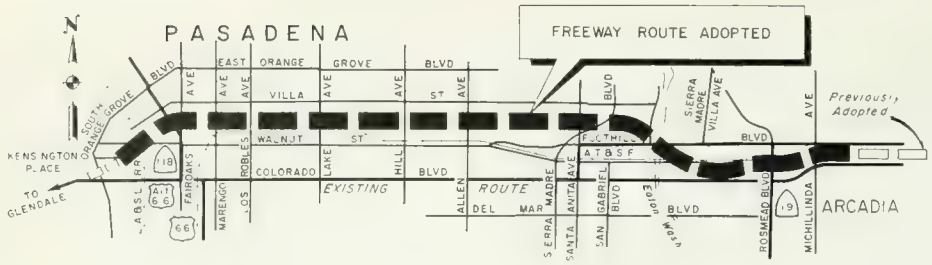
In the end, state engineers could have confronted the State Highway Commission with an adamant, economy recommendation. Instead the recommendation was softened by recognition that Pasadena's problems were unique, leaving the door ajar for commissioners to squeeze through onto Pasadena's side instead of having to repudiate their own staff in order to come our way.

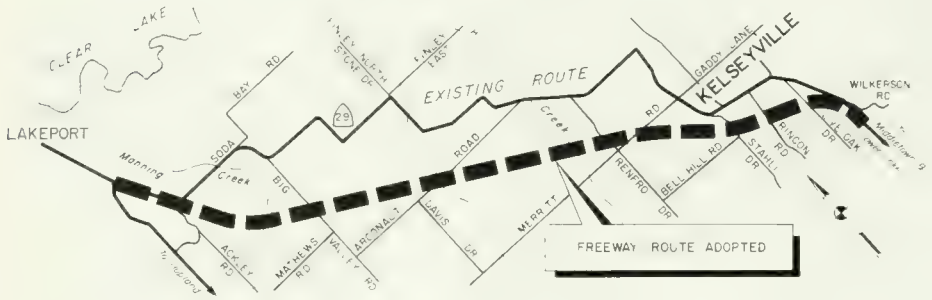
State engineers, themselves, are content with the verdict.



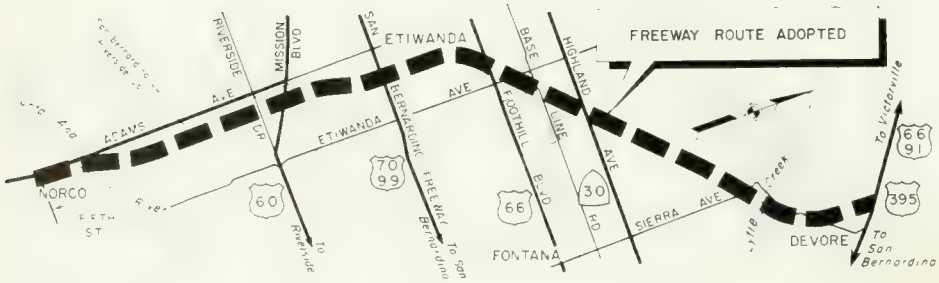


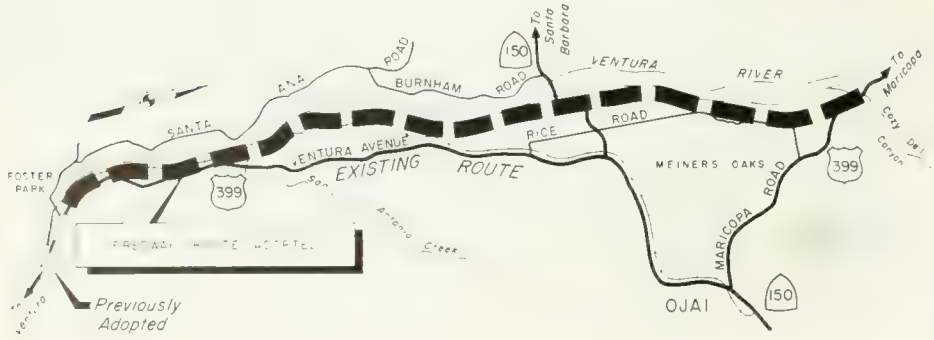
Seattle Public Library
SEP 7 1962











tenths of a mile of Sign Route 14 between Butler Avenue and Myrtle Avenue in the City of Long Beach.

Humboldt County—for the realignment of 5.5 miles of U.S. 101 between the north city limit of Trinidad and the easterly boundary of Patricks Point State Park.

Mendocino County—for 5.1 miles of Sign Route 20 between 0.7 mile west of Potter Valley Road and 0.6 mile east of the North Fork of Cold Creek.

Riverside and San Bernardino Counties—for the Devore Cutoff (State Highway Route 193) between Norco and U.S. 66-91-395 near Devore.

San Diego County—for 18.2 miles of U.S. 101 between the north city limits of Oceanside and the Orange County line.

Siskiyou County—for the relocation of 16 miles of U.S. 99 between the Shasta River and Granada.

Tuolumne County—for Sign Route 120 between the Stanislaus County line, 12.5 miles east of Oakdale, and seven miles east of the county line.

Ventura County—for 8.4 miles of U.S. 399 between Foster Park and Cozy Dell Canyon northwest of Ojai.

One conventional highway route was adopted. It is for the relocation of a little over two miles of U.S. 101 in Mendocino County between one mile and 3.5 miles north of Laytonville.

Construction Costs Show 15% Increase

An upturn in the California Highway Construction Cost Index took place during the second quarter of 1962. The index now stands at 271.1, an increase of 35.4 points or 15.0 percent over the first quarter of 1962.

The higher index reflects increases in materials and wages which have occurred in the construction industry, and is also affected by projects in California's mountainous areas, where difficult conditions tend to increase price averages.

The number of bidders per project during the second quarter dropped from 6.4 to 4.6.

Staff Promotions

Increased Levels of Responsibility Recognized

Creation of a new position of Metropolitan District Engineer in Los Angeles and appointment of two new Assistant State Highway Engineers has been announced by State Highway Engineer J. C. Womack. Womack said the new positions would enable the Division of Highways to recognize increased levels of responsibility in several metropolitan areas of the State.

Three Promoted

E. T. Telford was promoted from Assistant State Highway Engineer to Metropolitan District Engineer (a new class at the deputy state highway engineer level) in his present assignment as engineer in charge of District VII in Los Angeles.

Alan S. Hart was promoted from District Engineer to Assistant State Highway Engineer in his present assignment as engineer in charge of District III in Marysville.

Jacob Dekema was promoted from District Engineer to Assistant State Highway Engineer in his present assignment as engineer in charge of District XI in San Diego.



ALAN S. HART



E. T. TELFORD

E. T. Telford

Telford was appointed Assistant State Highway Engineer in charge of the Los Angeles district in 1956. A native Californian, Telford attended schools in Buellton, Santa Ynez and Santa Barbara. His first engineering job was with the City of Santa Barbara. Later he worked on railroad location, mining and with the U.S. Bureau of Public Roads. He joined the Division of Highways in 1927 as a civil engineer in the District VI office in Fresno. In succeeding years, he served in district offices in Bishop, Eureka and at Sacramento headquarters. He is a veteran of World Wars I and II, and returned to civilian life in 1946 with the rank of colonel.

Alan S. Hart

Hart was born in Santa Rosa and is a graduate of the University of California at Berkeley. His entire professional career has been spent with the Division of Highways, which he joined in 1928 between college semesters and to which he returned on a full-time basis upon graduation. He was District Engineer of District IX in Bishop before being transferred to a similar position in District I, Eureka, in 1953. He became District Engineer of District III in Marysville in 1957.

Jacob Dekema

Dekema was born in the Dutch East Indies and came to California from Indonesia in 1919. He is a graduate of the Los Angeles High School and the University of Southern California with a degree in engineering. He began work with the Division of Highways in 1938 and rose steadily through the ranks to become District Engineer in San Diego in 1955. He has held positions in Bishop, San Bernardino and at headquarters in Sacramento where he was Assistant Construction Engineer. He served with the Navy in World War II.



JACOB DEKEMA

State Launches Broad Motor Vehicle Study

The interrelationship of the citizen, his motor vehicle and his state government is the subject of a broad-gauge, pioneering study now entering its second and third stages in California.

The first stage—*the gathering of facts* about how the State manages its highway "plant," how it regulates drivers and their vehicles, and how it enforces traffic laws—was covered in 1960 in a report published by the Assembly Interim Committee on Transportation and Commerce.

The second stage—*analysis and evaluation* of the facts—is now in progress. Out of this evaluation will come the third stage—a *future program* keyed to the future needs of a state whose present 9,000,000 vehicles and 8,000,000 licensed drivers are expected to double in the next 20 years.

The task of completing the study has been undertaken by the State's new Highway Transportation Agency, which encompasses the state departments most intimately concerned with the problems of the motorist: the California Highway Patrol, Department of Motor Vehicles and Department of Public Works, which includes the Division of Highways.

The agency is being assisted by the Automotive Safety Foundation, 25-year-old nationally prominent research organization, under the guidance of a steering committee of state and federal officials; and by a battery of technical consultants and specialized study groups composed of interested and knowledgeable citizens.

The study is being financed out of California's share of federal-aid funds available to the Division of Highways for highway planning and research. Target date for its completion is September 1, 1963.

The A.S.F. staff directing the H.R. 381 study (referring to the Assembly resolution of 1959 under which it was undertaken) includes Louis R. Moroney and John H. Magill.

The steering committee includes the directors of the three state departments concerned, the State Highway Engineer, the Director of the University of California's Institute of Transportation and Traffic Engineering, a representative of the U.S. Bureau of Public Roads and State Senator Randolph Collier, Chairman of the Senate Transportation Committee and the Senate Fact-finding Committee on Transportation and Public Utilities.

The headquarters of the study is in the offices of the Director of Motor Vehicles in Sacramento.

C. G. BEER AND C. T. LEDDEN NAMED TO NEW POSTS

Appointment of Charles G. Beer as Urban Planner and of Charles T. Ledden as City and County Projects Engineer for the California Division of Highways has been announced by State Highway Engineer J. C. Womack.

Both positions are new. The post of Urban Planner has been established, Womack said, because of the increased importance of overall urban transportation planning in relation to state highways. The City and County Projects Engineer assignment is a combination of two previously distinct jobs.


C. G. BEER

Beer was recently appointed Engineer of Federal Secondary Roads upon the retirement of Harold B. LaForge.

His first assignment will be to supervise the preparation of a prospectus covering the scope and objectives of a comprehensive transportation study for nine counties in the San Francisco Bay area.

Ledden is being promoted from the post of assistant planning engineer, which he has held since 1950, to the new city and county projects position.

In his new position he will be responsible for state activities in connection with county road projects financed in part with federal and state funds and in connection with city street projects financed with state gasoline tax funds.


C. T. LEDDEN

"The combining of two previously separate jobs into one," Womack explained, "reflects the pattern of California's growth in population and traffic. City and county boundaries are becoming less and less significant in dealing with road and street problems, and it is being recognized at the federal as well as the state level that these problems must be solved on a comprehensive, areawide basis."

As chief assistant planning engineer, a position he has held since 1950, Ledden has been in charge of staff work and project review covering many miles of freeway and conventional highway.

A native of St. Louis, Missouri, Ledden came to California in 1925 and finished secondary school in Santa Clara. He graduated from the University of Santa Clara with a degree cum laude in civil engineering.

He started his engineering career with the Division of Highways in 1931 in District IV which has headquarters in San Francisco. His assignments included construction in the Santa Cruz area, on the San Francisco-Oakland Bay Bridge, the Waldo Tunnel and in the District IV headquarters office. From 1943 to 1950 he was chief draftsman and design engineer in the district.

Beer moves to the new position of Urban Planner from a post as Engineer of Federal Secondary Roads to which he was appointed earlier this year. He was previously assistant district engineer in charge of administration for District VIII, with headquarters in San Bernardino.

Beer is a native of Los Angeles and received his bachelor's degree in civil engineering at the University of California in Berkeley. He received a master's degree in meteorology in 1945 at U.C.L.A., in the course of his World War II service as an Air Force meteorologist.

He has been on the Division of Highways staff for 26 years, serving in bridge engineering, traffic engineering, and other fields.

Petaluma Bypass

Effect on Specific Businesses And the Community Is Analyzed

A REPORT OF THE LAND ECONOMIC STUDIES SECTION, RIGHT OF WAY DEPARTMENT

Summation by JAMES H. HAMPTON, Right of Way Agent



THE CITY OF Petaluma (population 14,000) is located 38 miles north of San Francisco on U.S. Highway 101, the primary coastal highway leading north through the redwoods to Oregon and Washington. The city services a large rural area which provides most of the business for the community. The nearest and most important competitive community is rapidly growing Santa Rosa, the county seat (population 31,000), located 16 miles to the north on Highway 101.

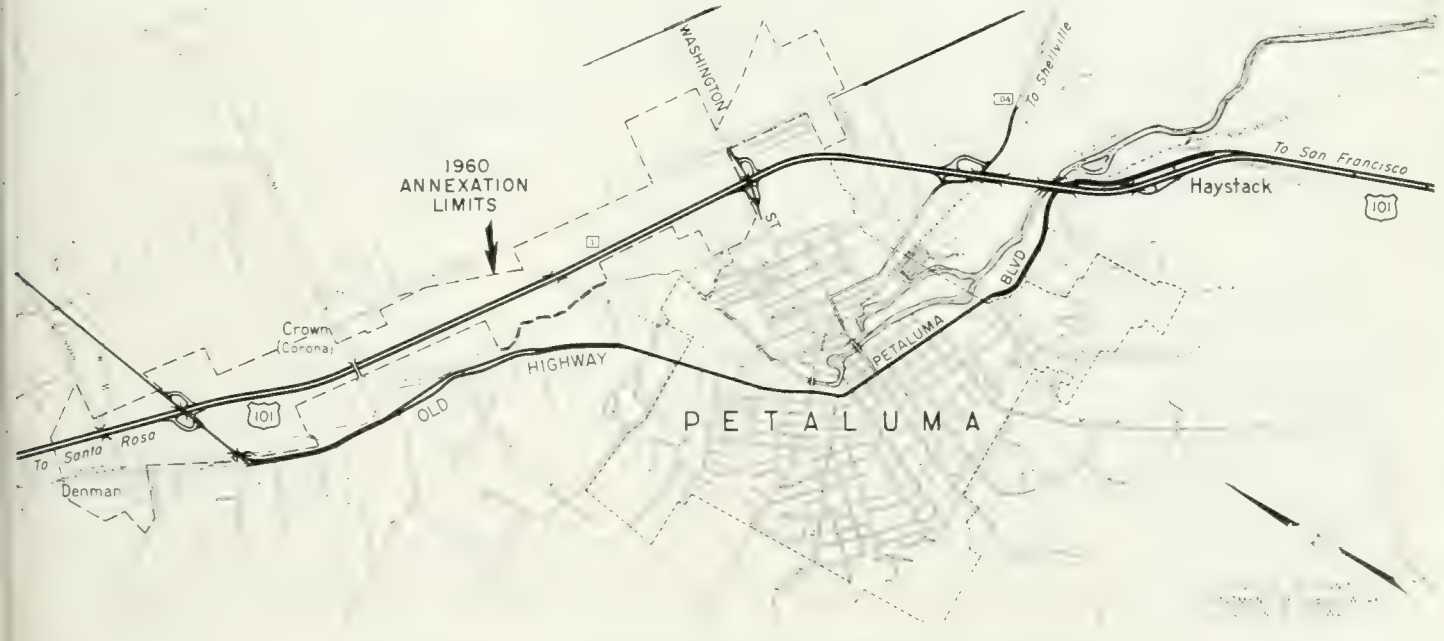
Prior to the opening of the bypass, on November 16, 1956, through highway traffic was carried by Petaluma Boulevard, the main street of town. Traffic counts taken in June 1956 indicated an average of 21,800 cars per day used the street. Counts taken in May 1957 indicated 12,000 per day were using Petaluma Boulevard and that the remaining 45 percent of the total traffic had been diverted to the bypass.

There was considerable concern by local merchants and business people that the diversion of this traffic would have disastrous affects on business and property values along Petaluma Boulevard and even on the community as a whole. In fact, a number of service stations and a food market did close. And a major chain store also closed at the expiration of its lease in 1958. The latter especially was cited by many people as an example of damage to the community by the diversion of customers to the bypass. The closures plus the fact that the easterly (river) side of Petaluma Boulevard appears less active and contains a higher percentage of vacant buildings than Kentucky Street which parallels Petaluma Boulevard one block west, gave an initial reaction that the bypass could have had a considerable affect.

Other Changes

As this study progressed it became evident that the opening of the bypass was just one of a number of changes and shifts that the community has experienced in recent years. It was therefore necessary to determine what effect other changes of an economic nature may have had on the community.

Mr. Frank Toner, a leading banker of Petaluma, commented on some of these changes in a speech to the Fortuna Chamber of Commerce. Mr. Toner had been a banker in Fortuna and had been invited to present the experience of Petaluma to guide Fortuna in adapting to a bypass route which has just been completed. Toner said:



A map of the Petaluma area showing the location of the freeway and the old highway.

"A town's appearance as to cleanliness makes a remarkable change after bypass. In our town, most of the hay trucks, large cattle trucks, oil tankers, and in your case lumber trucks, previously routed right down our main street, now go around or are routed through a less congested area. The branch of our bank in which I work is located on a main intersection in downtown Petaluma and I can readily recall the difficulty experienced in trying to carry on a conversation with truck after truck rumbling by not more than 15 feet away. The fumes and dust, while not entirely eliminated, have certainly been minimized. Ask a truck driver how he feels about bypassing a heavily congested shopping area."

Mr. Toner concluded:

"The highway bypassing your town is not a thing to fear or dread, but rather should be taken as a challenge. It will create opportunities impossible to imagine at the present time. Accept the loss of a lot of cars jamming your main street and go out after the shoppers' dollars in adjacent areas. Emphasize the benefits of shopping in your town; don't be negative and feel that you're doomed. Be patient, and above all be practical. You will not regret the highway by-passing your town in the years that follow."

History, Economic Background

Petaluma is the oldest town in Sonoma County, having been incorporated in 1848. For many years in the early 1900's it was the primary shopping and business center in the entire area. Its importance stemmed from the existence here of the terminus of the navigable tidewater of the Petaluma River. Much agricultural produce, chickens and livestock were brought to Petaluma to be shipped by barge to San Francisco. There were many commission merchants, located mainly on the easterly (river) side of Petaluma Boulevard and the hotels in town did a thriving business. Petaluma Boulevard, being adjacent to the river, was the primary center of activity.

In recent years the primary shopping area has moved to Kentucky Street, located one block west of Petaluma Boulevard. The movement to Kentucky was occasioned by the lessening of importance of barge transportation and the increasing space requirements of the automobile. The river, instead of being an advantage, became a disadvantage by causing confinement of adjacent buildings between it and Petaluma Boulevard. Reduced foot traffic along the easterly side of Petaluma Boulevard, perhaps to some extent caused by the crush of traffic on the street, further reduced the utility of these buildings in relation to those on Kentucky Street.

The major chain store originally leased its site on the easterly side of Petaluma Boulevard in 1929, when this was a prime location. In recent years, due to confinement by the river, parking became an increasing problem.

The chain's decision not to renew its lease in 1958 was a result of company policy to close smaller stores and concentrate on more modern stores in the larger communities. The chain now has branches in the two nearby cities of Santa Rosa and San Rafael.

A number of local merchants were questioned about the former chain store and adjacent buildings which have remained vacant. The general reaction was that the low amount of foot traffic, limited parking, and the fact that the buildings were old, resulted in their having limited utility. Only one merchant out of more than a dozen who were questioned on this subject, indicated he felt the reduced traffic on Petaluma Boulevard, as a result of the Bypass, was a cause factor in these buildings being vacant.

Community Sources of Income

Into the early 1950's agriculture provided most of Petaluma's income; divided mainly between poultry and dairying, with poultry being the most important. The poultry industry, starting about 1955 suffered some radical changes and now has dropped in importance to Petaluma businesses, but probably remains slightly more important than dairying.

In a discussion about the source of his business, a leading Petaluma home appliance retailer stated that only about 30 percent of his business is now from ranchers. The remaining 70 percent is from people in town, particularly those living in the new subdivisions. Many of the latter are commuters who work outside the community. It should be noted that appliances would be needed more by owners of new homes than the general population and hence would not be representative of the source of all business of the community.

Manufacturing is providing a small but increasing income to the community and is expected to accelerate as the City is able to provide utility services to a new industrial park area adjacent to the freeway.

The Poultry Industry

Petaluma's importance as a poultry center dates from 1902 when Lyman Byce, a local resident, invented and perfected the first mechanical incubator. *Westways* magazine in the March 1954 issue stated: "Nowhere else in the world are there so many hens, mostly white leghorns, within so small an area."

However, as the above quote was being written, major changes were shaping up. The price of eggs was dropping from the 50 cents per dozen range in the early 1950's to 40 cents in 1954 and downward to 36 cents in 1957. This resulted in a severe shakeout of the smaller operators during the same period that the freeway bypass was opened. The chicken business became concentrated in larger, more efficient operators, and small, older, chicken houses were abandoned.

While the number of eggs produced in the area is not much less than before, labor input per hen has dropped from 1.4 man hours in 1950 to .7 man hour per hen per year in 1960 (figures from Sonoma County Agricultural Extension Service). This has resulted in a lower percentage of total poultry income coming into the shopping area of Petaluma.

However, the picture was not as black as it might seem for the merchants of Petaluma. Most of the former chicken ranchers remained in the area, becoming employees of the large feed companies, or of large chicken ranches or found other jobs provided by a growing community. Some commuted to other communities such as Mare Island, (27 miles east), Santa Rosa (16 miles north), San Rafael (21

miles south) or San Francisco (38 miles south). In some cases they had more money to spend than before. It will be noted in the charts later in this report that retail sales in the city did not drop during this adjustment period.

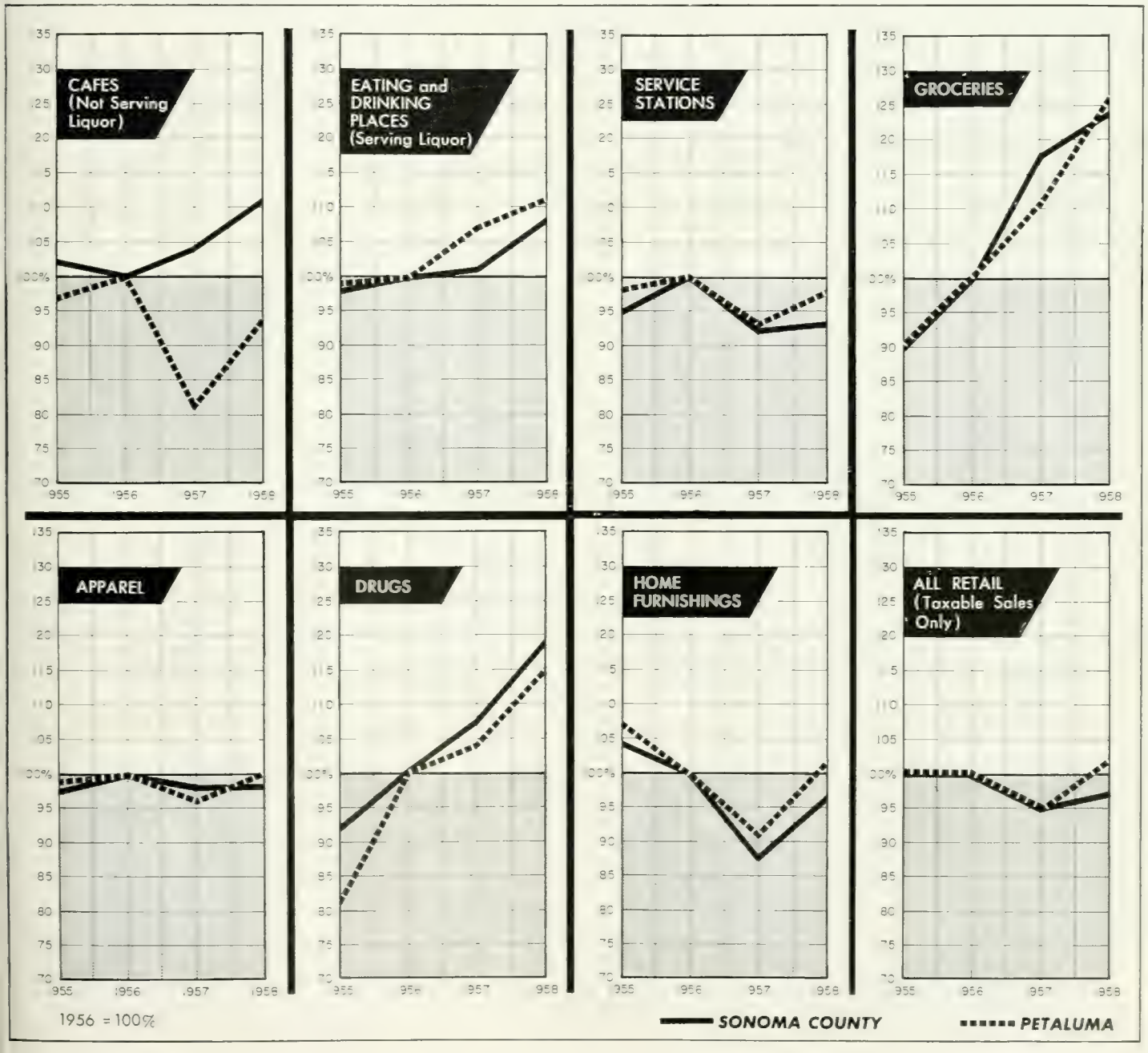
The Bypass Itself

The first public meeting to discuss the proposed bypass was held in September 1948. Shortly thereafter the *California Farmer* reported the formation of the Petaluma-Cotati Freeway Association, composed of 140 chicken ranchers and others. This group was organized to protest the proposed routing which was to go through many of their ranches. The members argued that 120 chicken ranches with a monthly gross income of $125,000 would be destroyed. On July 21, 1959, 65 of these ranchers did their chores early and embarked in a caravan to a meeting of the State Highway Commission in Sacramento where they delivered their reasons for rerouting. Prior to that (on July 8, 1949) the local board of supervisors had, at the ranchers' behest, reversed its original stand and recommended rerouting. The highway commission concurred with the route change recommendation and the present alignment which curves about ¾ mile to the west of the originally proposed routing was adopted. Construction was started on July 1, 1953 and the bypass was opened for traffic on November 16, 1956.

Entrance to Petaluma

Petaluma now has three major entrances. The north entrance is located

PETALUMA BUSINESSES



three miles from the business center where the old alignment crosses the new. The middle (East Washington Street) entrance is one mile east of the business center and the south entrance is located two and one-half miles from the business center.

The north entrance has been developed with two new service stations. A former lumber yard office building has been converted into a restaurant. There are additional large developments proposed for the area around this interchange as soon as the city can make utility services available. In preparation for this the city in 1960 annexed a large area (675 acres) adjacent to the freeway between the middle and north entrances. The area is planned as an industrial park.

The middle interchange has developed most rapidly. Subdivisions were being constructed in the area at the time the freeway was built and additional houses have since been completed adjacent to the freeway.

The middle interchange location is developing into a major shopping area. A major supermarket moved from downtown Petaluma to a new location here and additional stores are now being constructed. A 36-room motel with swimming pool and a new restaurant was built. The location is without question the most rapidly developing area in the community.

There has been no commercial development around the south entrance. The location is such that there is little advance notice of its proximity, since cars are coming up over a rise in the road just prior to arriving at the turnoff. In 1959 additional lighting and a larger sign were installed by the Division of Highways at this turnoff, after which the local paper printed an editorial of appreciation. Most tourists, however, continue to use the East Washington Interchange for entrance to Petaluma.

On and off ramps connect Shellville Road to the freeway at the foot of the Petaluma River Bridge. This connection is of minor importance and has attracted no development.

Individual Businesses

In order to measure the effect of the diversion of traffic, the business records of 150 (nearly 90 percent of all) merchants in Petaluma were used to develop sales indices.

Since the opening of the bypass was an immediate action, i.e., not spread out in time, it was possible to make relatively accurate before and after measurements. Sonoma County sales tax summaries were used as checks to measure how Petaluma businesses deviated from areawide trends. The entire year 1956 was used as a base, or 100 percent, and changes were measured as percentage increases or decreases from this base. If a particular business was operating at a certain rate through 1956, then shifted to a new and steady rate starting in 1957, this step between 1956 and 1957 was considered a bypass effect. If a business had developed a trend of gain or loss prior to the end of 1956, and this same trend continued in 1957 and 1958, without an unusual shift in 1957, it was presumed that other factors were causing the change.

Interviews were conducted with most of the business people in town to determine any unusual factors which may have been present during the period under study. Certain businesses, particularly small restaurants, sometimes changed hands so frequently it was impossible to get meaningful information. These in general were low volume operations which had little competitive effect on the community.

Voice Friends' Views

It was interesting to note that, in a number of interviews, when a businessman complained about the bad effect of traffic diversion on business, it was not his *own* business that suffered; it was the fellow down the street. Occasionally someone would state the bypass had no effect on his business when actually his sales tax reports showed a considerable reduction. It appeared that when a merchant's analysis did not correspond with the facts, he was actually voicing the views of his friends or he was preserving a position he had previously taken among his friends, or he was using the bypass to explain a continuing loss of business due to other causes.

To gain perspective on the effect of the bypass on the community as a whole it is necessary to weigh each type of business according to its dollar importance in the community. The following table gives the approximate percentage of the total taxable and nontaxable retail sales in Petaluma that each type of business contributes. These percentages will vary of course from year to year and hence they are rounded to the nearest 5 percent.

	Percent
Motor Vehicle	20
General Merchandise	15
Grocery	15
Lumber and Hardware	10
Farm Implement	5
Apparel	5
Drug	5
Home Furnishings	5
Service Stations	5
Eating Places Serving Liquor	5
Cafes	5
Other Retail	5

It will be noted later that the cafes were the only group which was adversely affected by the opening of the bypass and they make up a relatively small percentage of the community retail trade. Service stations, cafes, bars and restaurants, which have been found to be the businesses most sensitive to traffic diversion, contribute 15 percent of all retail sales to the community's economy. This low percentage indicates that Petaluma was not particularly oriented to serving highway traffic.

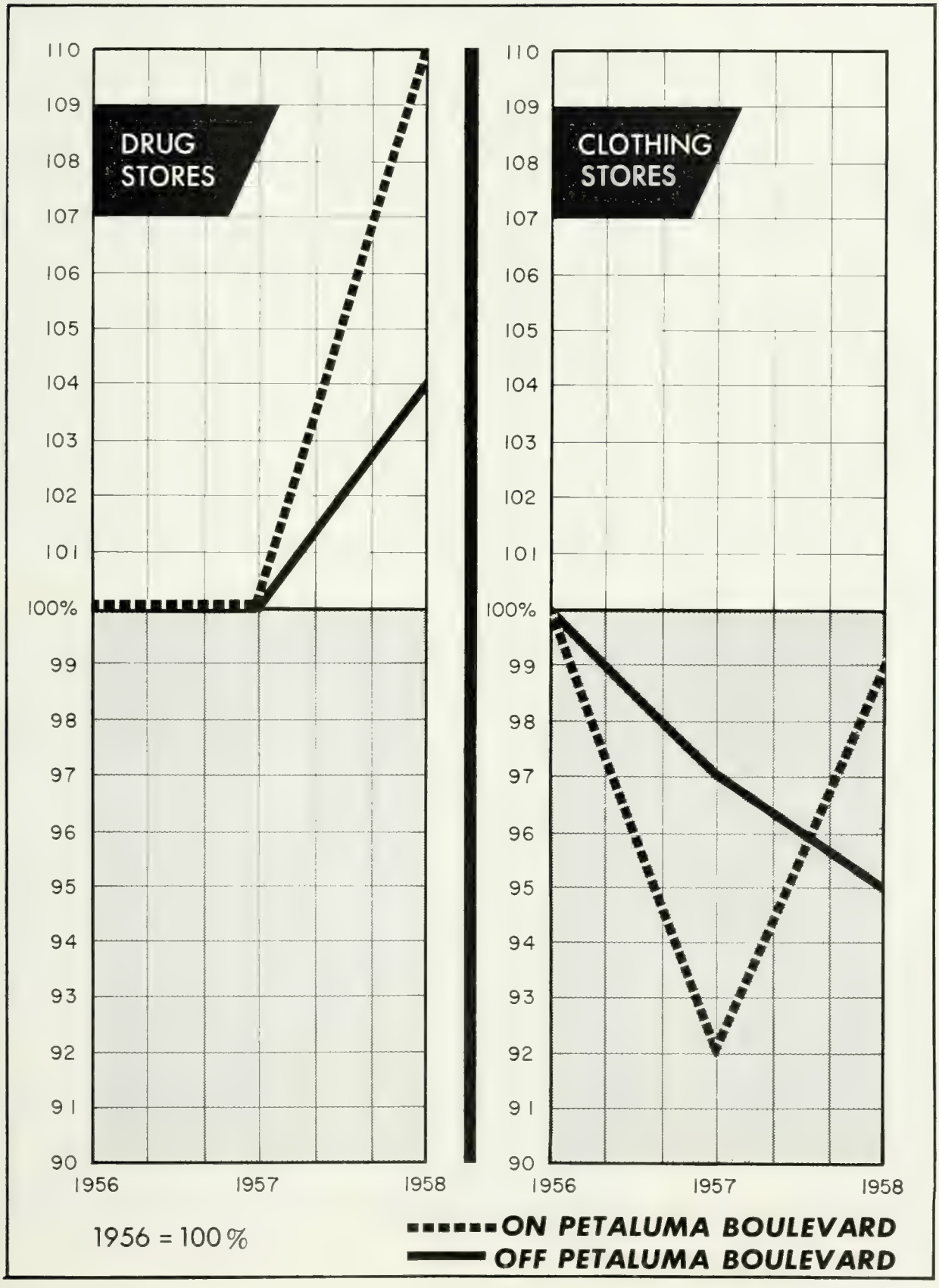
Service Stations

The changing traffic patterns resulting from the bypass strongly affected many service stations, but by no means all of them. One of the purposes of this study was to determine what affect an individual service station operator may expect based on the experience of similarly situated Petaluma operators who have faced the problem.

As noted on the following chart, *Sonoma County* service stations experienced a business drop of 8 percent in 1957 and gained slightly to 7 percent below 1956 in 1958.

Petaluma stations, overall, dropped a similar amount in 1957 then recovered to within 2 percent of the 1956 sales in 1958. This considerably exceeded the countywide improvement.

ON and OFF COMPARISON



However, these bare statistics do not tell the whole story.

Those stations on the superseded highway lost an average of 20 percent of their business in 1957. Two stations lost more than 30 percent of their gross sales (which included nontaxable items.)

Most severely affected were those stations on the incoming lane of traffic. These lost an average of 21 percent of their gross sales. Stations on the outgoing lane of traffic lost an average of only 15 percent. However, most of this latter loss was caused by one station which continued to lose strongly in 1958 compared to 1957. This suggests that other factors besides the bypass were important. The other stations on the outgoing lane showed less loss than the county average after the bypass was opened.

One operator on Petaluma Boulevard lost 16 percent of his gross and 28 percent of his gallonage in 1957 compared to 1956. However, he stated that: "The gross business of the station was down but by trimming the help, which was mainly for gasoline customers, my net did not show a loss." He was probably more successful than average in meeting the challenge. He frankly stated that prior to the opening of the bypass, he strongly considered selling his station because of his concern about what would happen. Since 1957 his gasoline sales have been steadily increasing until today he is pumping at nearly the same rate as he did in 1956.

Citywide service station sales were boosted by a new high gallonage station opening in May, 1956 on East Washington, the middle entrance route, and a second new station opening in March, 1957 on this same street. Business at these two stations more than made up for the loss of business on Petaluma Boulevard and probably also affected the sales patterns of existing stations. Since then, three more stations have been constructed on this same street. Also, two new stations have been constructed on Petaluma Boulevard, the old highway route; two more stations have been built at the north freeway entrance and one at the middle entrance on East Washington.

To summarize the effect of the bypass on service stations, the following conclusions are evident:

1. Since the opening of the bypass five stations have closed. All were older, low gallonage stations. Ten new stations have opened, during the same period. The permanence of the new freeway and an expanding population have contributed to the new growth.
2. Stations on the outgoing lane of traffic apparently served mainly local customers and were affected little or none by the bypass opening.
3. New stations were opened which more than made up for loss of business of the other stations.
4. Existing stations adapted to new conditions by catering to local repeat customers, cutting down on hours and labor, and emphasizing service and repair work.

Motels

There were two motels serving highway traffic in town in 1956. One of these is near the downtown area on South Petaluma Boulevard. The other is on North Petaluma Boulevard about a mile north of the business center.

The "plight" of Petaluma was the subject of a widely quoted article in the *Wall Street Journal* in 1957. In the article the proprietress of one of the motels was quoted as follows: "We'll have 14 to 16 empty buildings in the next 30 to 60 days. Petaluma is a ghost town." This was written a few months after the bypass was opened and for many merchants on the old alignment who were used to the pressure of traffic, the "silence was deafening" at the time.

However, both motels remained in business and both in recent years have been refurbished. Recently, both motels reported a steadily increasing business—mainly from repeat customers—despite the addition of the new motel at East Washington Street.

The hotels in town have never benefited much from highway traffic and apparently were little affected by the bypass.

The cafe section of the accompanying series of charts on "Petaluma Businesses" illustrates the only major drop of a Petaluma business group compared to Sonoma County averages. Petaluma restaurant business dropped 19 percent in 1957, at a time when Sonoma County restaurants improved 4 percent. Restaurants along the northeast (river) side of Petaluma Boulevard lost an average of 31 percent of their gross while those on the westerly side lost only 17 percent, indicating again the low amount of foot traffic on the river side of Petaluma Boulevard. Restaurants in town off Petaluma Boulevard maintained a steady gross during the period.

Generally, the restaurants adapted to new conditions by catering to more local and repeat customers. One operator stated that he shifted from hamburgers to steaks. In all cases it was necessary to improve the food so that customers would return. This was apparently not necessary when there was continual "drop-in" traffic from the highway. Since 1957, adjustments by restaurant owners have resulted in a steadily increasing trade.

In contrast to the restaurants that did not serve liquor, the bars, taverns and restaurants which served liquor were not affected by the bypass, or if they were, they benefited. Some of the best restaurants in town are in this group and undoubtedly their clientele included more local people than transients.

Other Businesses

The remaining charts are for those businesses not generally sensitive to highway travelers. Various conclusions can be speculated in each case. However, in general, considering the entire group, it is evident that Petaluma fared somewhat better than did its parent county during 1957 and the disparity was accentuated in 1958. Some merchants in town feel that the business increase is due to the more pleasant shopping conditions in Petaluma since the removal of through traffic.

The disparity is further accentuated by a comparison of population growth rates. Petaluma gained population at an average rate of 3.3 percent per year between 1950 and 1960, while Sonoma County was growing at the rate of 3.7 percent per year.



Petaluma's main business district is adjacent to the left branch of Petaluma Creek near the center of the photo. East Washington Street connects with the freeway at right center.



he subdivision at left was planned along the right-of-way line of the future freeway. The orchard in he center is now a junior high school site. East Washington Street interchange is under construction in this 1957 photo.

On and Off Comparisons

There was sufficient information on drug stores and apparel stores both on and off Petaluma Boulevard to make an on-off comparison (see accompanying on and off charts). It is believed that drug stores are a better measure of the public's reaction to a shopping location than apparel stores because drug stores carry a more diversified line which would be less subject to individual management decisions. It can be seen that both types of businesses on the old highway were doing better in 1958 than their counterparts in other sections of town. However, this relative improvement did not commence until a year after the opening of the bypass. The delay could have been due to the uncertainty of merchants in launching promotional campaigns after the diversion of traffic and to the slowness of the general public to change established shopping habits.

The manager of a major nationwide clothing store located on the westerly side of Petaluma Boulevard was quoted in an advertisement in a national magazine in September 1959 as saying: "Our store is on Main Street. Before the new road, we couldn't carry on a conversation because of the noise of trucks. If we opened the door we got a noseful of fumes and dust. Our business has never been better than it is now."

Petaluma Boulevard

Property sales were secured throughout the commercial area of town, but it was impossible to develop sufficient good data within the scope of this report to draw any conclusions. Commercial property sales are generally very complex with trades, leases, tax factors, financing arrangements and large building-land ratios all combining to make each sale a maze of complications.

Therefore the leading realtors who owned commercial property on Petaluma Boulevard were consulted for their opinions. There was general agreement that commercial property values on Petaluma Boulevard had remained stable over the past 10 years and that the diversion of traffic to the bypass had had little effect. It was felt

that the only commercial area in town that had deviated from this static situation was East Washington Street, where values had increased three times or more; and areas near the freeway, particularly at the East Washington Street overpass, which were also increasing rapidly.

Also there was some indication of a rise on North Petaluma Boulevard near the city limits where a shopping district has been proposed. Residential property values throughout the city have continued to rise along with county trends in the past 10 years.

Safety Benefits

Aside from strictly economic effects, Petaluma became a safer place both for pedestrains and for autos after traffic diversion. The police chief reported that the citywide accident total dropped from 1,178 for the three years prior to the bypass to 895 for the three years after the bypass. Pedestrian accidents, involving crossing Petaluma Boulevard, dropped considerably. The latter subsequently became very important due to the construction of a new junior high school on the east side of town which drew students from across Petaluma Boulevard.

Summary

Eleven categories of business in Petaluma were compared to a norm of similar businesses throughout Sonoma County. Sales information was gathered from state tax records for most of the businesses in town. In addition, a majority of the business people were interviewed to get their personal reaction to the bypass and how it affected them.

The results indicated that—

1. Local conditions were more important than the bypass in the overall community business volume of Petaluma.
2. The only category of business in Petaluma that suffered a loss due to the bypass was cafes (not serving liquor). These represented 5 percent of the overall business of the community. The loss of business of the cafes due to the diversion of traffic avaraged 19 percent. Most affected were those cafes with little foot traffic to draw from to replace the traveling public. Cafes adapted to the new conditions by catering to local and repeat customers, by improved food, and by shifting from short orders and hamburgers to steaks and full course meals.
3. Bars, taverns, and restaurants serving liquor suffered no loss of business and in some instances may have been helped by the diversion of traffic.
4. Service stations, communitywide, did at least as well as the Sonoma County average. However, individual stations, particularly those on the incoming lane of traffic, lost an average of 21 percent of their gross sales (taxable and nontaxable). These stations adapted by reducing costs and catering to more local and repeat customers. Stations on the outgoing lane of traffic were not affected by the diversion of through traffic since apparently most of their customers were local. New stations were built which were generally high gallonage, and these more than made up for the losses described above and for the older, outdated stations which closed down.
5. The preferred area of new commercial growth is located adjacent to the new freeway and near the new subdivisions where the facilities can conveniently serve both local and traveling or commuting customers.
6. Property values along the old alignment (Petaluma Boulevard) were unaffected by the diversion of traffic.
7. Motels have adapted by refurbishing and attracting more repeat customers.
8. After about a year the shopping public began to move back to Petaluma Boulevard resulting in those businesses on the old alignment gaining more than their counterparts in other sections of town.
9. Accident rates throughout Petaluma were reduced 25 percent by the diversion of traffic.

Illustrated Booklet Explains Road Work

"We're Going to Be Neighbors" is the title of an illustrated booklet distributed to residents of an area in and near San Jose where construction began recently on the first unit of the Junípero Serra Freeway.

Source of the booklet is the joint venture contractor on the project, Gibbons and Reed Company of Burlingame and Dan Caputo Company of San Jose.

Its purpose: to explain to the neighborhood the nature and purpose of the freeway construction work and to appeal, particularly to parents of youthful "sidewalk superintendents," for co-operation in the matter of safety.

Detour plans are also explained, coupled with a request for observance of posted traffic control and speed control signs.

The booklet is informal in tone, and covers not only basic information about the immediate project but also the individual's stake in highway improvement:

"You have a personal stake in better highways if you own a car, drive to work, drive to another town, or have children old enough to drive a car. You have a personal stake because of the higher standards of living highways promote; the increased business and tourist trade; and because of the higher cost to you, the taxpayer, of using *inadequate* highways. . . ."

The names, office addresses and telephone numbers of the people in charge of the project representing the Division of Highways and the contractors, are included.

Public reaction to the booklet has been excellent, according to District IV Construction Engineer Carl Hendrickson. Parents, in particular, have indicated an active interest in safety problems involved.

Distribution of the booklet was door-to-door, with the assistance of a local Boy Scout troop, as arranged by the contractors.

Reduced Plans

Up-to-date Processes Realize Large Savings

By HARRY CHOI, Special Services Highway Engineering Associate

The large, unwieldy roll of blueprints, long characteristic of an engineer, is rapidly being replaced. Modern reproduction methods are furnishing today's engineer a more convenient means of job control.

Program Initiated

In July 1954 the reduced size plan program was initiated by headquarters reproduction section using the offset process of printing layout sheets for construction contracts. This process, with subsequent modifications, has resulted in substantial savings to the Division of Highways as well as offering many other advantages. These savings are realized through the use of up-to-date processes which permit the use of plain sulphite paper rather than blueprint paper.

The cost per sheet of reduced plans is about one-third the cost of a full-size (23" x 36") blueprint sheet. The reduction of size to one-half scale reduces the shipping weight to approximately one-quarter of that required for full-size plans.

Other Advantages

The reduced plans offer other advantages. Primarily, they are much handier and therefore lead to a greater use by field personnel which helps make everyone concerned more conversant with the construction details. Also, they may be marked with a regular pencil rather than requiring a special marking pencil. The earlier availability of the plans due to speedier processing provides more time for contractors to review projects. The lower cost also encourages more contractors to take out plans for projects.

Original Process

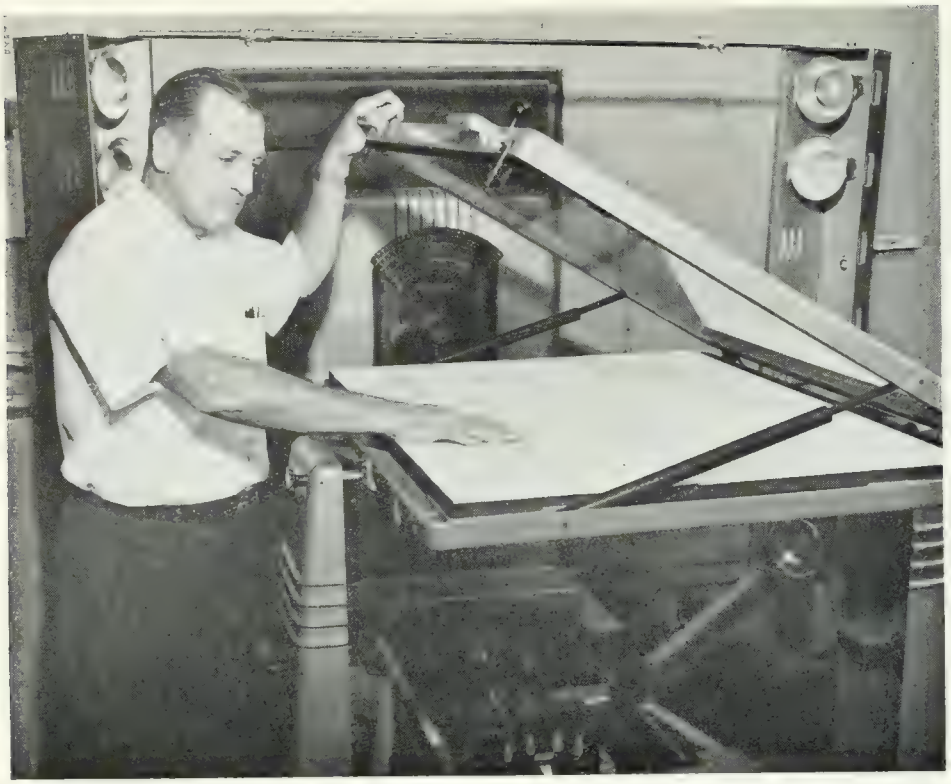
The original process employed in preparing the reduced-size plans involved the following steps in handling the tracings or drawings:

1. Photography of the original on film at one-half scale.
2. Special treatment of the developed film.
3. Preparation of a photosensitive offset paper master from the film.
4. Printing from the master by an offset duplicating machine.
5. Collating of the printed sheets into sets.

The first step, photography, was simply handled provided the original material was of satisfactory quality with adequate contrast whether inked



Reproduction Machine Operator Donald Geiger demonstrates the transferring of a plan image to an offset paper master.



A plan is placed on the copyboard preparatory to making a photocopy of it by Senior Operator William J. Almond, Jr.

or pencilled. Difficulties were encountered in photographing diazo intermediates or any material which consisted of drawings with any part on both sides of the tracing.

Print Is Photographed

Diazo intermediates and tracings with both sides of the paper or cloth used required that a print be made in blueline or blackline. This print then had to be photographed as direct photography of such material is not possible. Diazo intermediates also invariably darken and deteriorate, which caused the background to be photographed with consequent loss of contrast and generally unastisfactory results.

Bottleneck Develops

During the early months of 1958 the increase in requirements reached the point where the division was experiencing difficulty in maintaining adequate production. The bottleneck that developed was due to the inability to process film negatives and offset masters on existing equipment with the speed required to meet the workload demands.

Dry Process

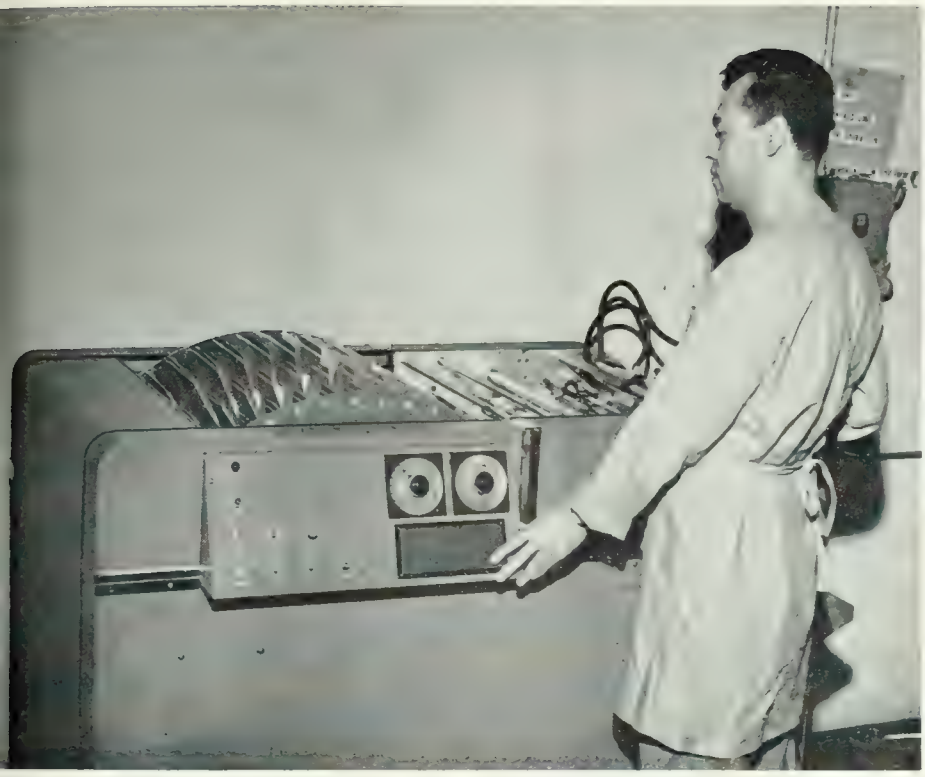
To break this bottleneck the dry electrostatic copying process for the preparation of paper offset masters was put into effect in October 1958. This method eliminated the necessity of making a film negative. It was a simple matter to reduce the originals and transfer them to offset masters for the immediate reproduction of permanent highly detailed copies. A time study test proved that a master was prepared in one-third the amount of time. A cost study showed that there was a 30 percent reduction by use of the electrostatic process. The quality of work produced was adequate and better than that produced on the existing equipment. However, there was difficulty in obtaining the solid areas and light pencilled lines on the originals.

Work Multiplies Six-fold

From 1954 to February of 1962 the work load has multiplied over six times. In order to meet the ever increasing demand, the division changed over the present patented method, obtaining a direct photographic image on a reproducible master which increased the production about 10 percent and reduced the cost another 20 percent. This amounts to a savings of over 50 percent from the film negative



Supervisor Robert Freer (center) checks prints runoff on duplicating machines from processed offset paper masters with operators Charley Reynolds (left) and David Smith (right).



Operator Tom Sandoval collates copies of the plans.

ethod. Additionally, this method ffers the following advantages:

1. Solids and bold-faced type headings are reproduced alongside fine detail without mottling.
2. A wide variety of halftone copy can be reproduced with acceptable fidelity.
3. Little or no clean-up time or fill-in work is required.
4. No shadow lines to remove when working with paste-ups.
5. Additions or deletions can readily be made prior to printing.

This method has produced offset asters capable of yielding clean and arp copy that is most desirable.

Basic Standards

Careful consideration was given to e use of proper methods in produc- g drawings with high contrast so ey were compatible with reproduc- on processes for reduced size plans. order to secure completely legible duced size plans certain basic stand- ds were observed. The division set rth the following requirements:

1. Drawings shall be prepared on cloth, paper or polyester base film using either pencil, ink or typing. All hand lettering should, if at all possible, be held to a minimum height of three-sixteenths of an inch and under no circumstances should hand lettering smaller than one-eighth inch in height be used. For mechanical lettering, the minimum should be 0.140 inch with 0 or 00 pen.
2. The types of "duplicate" tracings that will be acceptable for contract plans are cloth, paper or polyester base film duplicates of the silver emulsion type, excluding diazo duplicates.
3. All "originals" sent to headquarters office as a part of contract plans shall have the material to be reproduced confined to one side of the sheet and it shall be direct reading.
4. No shading or coloring will be allowed on contract plan tracings. This will not reproduce photographically on reductions and blanks out dimensions on diazo reproductions.
5. Combination of ink and pencil work will not be tolerated on the same sheet due to difficulty in obtaining legible reproductions

. . . Continued on page 48



A completed set of plans is being punched on a multiple-head drilling machine by operator Charley Reynolds.

Full Freeways Now Total 1,000 Miles

California has opened its 1,000th mile of multilane full freeway, Governor Edmund G. Brown has announced.

The state's highway system now includes a total of 2,425 miles of completed multilane divided highway of all types, including about 850 miles of expressway—access controlled, like the full freeways, but with some crossings still at grade.

The 1,000th mile of full freeway—with all crossings separated by structures and no left turn movements—was opened to traffic on July 14. It was a 2.8-mile section of U.S. 101 bypassing the City of Fortuna, in Humboldt County.

Runners-up Listed

Runners-up for the "milestone" honor were two sections of freeway in the Los Angeles area—a 3½-mile section of the San Diego Freeway near Long Beach which opened on July 5 and a one-mile extension of the Hollywood Freeway in North Hollywood, which opened July 16.

"California is still the leading state in construction of modern tollfree multilane freeways and expressways," the Governor pointed out. "This achievement is directly due to a combination of farsighted legislation, sound long-range planning, and the finest brand of engineering skill on the part of the Division of Highways.

More Under Construction

"I am proud of the fact that more than 300 miles of full freeway have been opened to our motor vehicle users in the past 3½ years, and that more than 400 miles are under construction right now. This means the saving of millions of dollars in operating costs to highway users, and, more important, hundreds of lives, because these freeways are the safest as well as the most efficient motor vehicle facility yet devised.

"I commend Director of Public Works Robert B. Bradford, the rest of the Highway Commission and the whole Division of Highways for the efficient and well-planned way in which the freeway network is expanding all over the state."

The Governor also took note of a report from the Highway Commission that it has adopted route locations, after provision for public hearings, for a total of 6,200 miles of freeways. This represents half of the 12,400-mile system of freeways and expres ways established by the legislature 1959, he pointed out. The freewa expressway system is scheduled f completion by 1980, connecting California communities of more th 5,000 people and carrying 60 perce of the total traffic.



Duplicating Machine Operator Bob Humphrey stacks plans of various projects which will be shipped to the districts.

Reduced Plans

Continued from page 47 . . .

on account of unequal values of contrast.

6. Appliques of symbols and letters cannot be used on contract plans due to impermanency.

Conclusion

This new combination provides t division with a most efficient mea of reproducing reduced size contra plans rapidly at low cost.

Evaporation Rate

Apparatus Measures Water Loss During Construction Operations

By RUFUS M. HAMMOND, Assistant Highway Engineer

As highways are essentially outdoor ructures they must endure all the ariations involved in climatic con-itions. Undoubtedly no other ele-ent has such a profound effect on l aspects of highway engineering as oes water. Virtually all soils would e completely stable and present few roblems if they were dry. Water uses rusting of steel structures and eterioration of most materials. It has een called the universal solvent. Vater is an essential in the manufac-re of portland cement concrete and ater loss must be prevented for roper curing. The question of how ng water remains in place on the rface or in the pavement structure often a matter of considerable im-ortance and therefore an accurate nowledge of the potential evapora-on rates can be important.

For example, the curing of portland ment concrete is relatively simple here there is no loss of water due to aporation, and can represent a seri-s problem when evaporation losses e rapid and extensive. The successful nstruction of seal coats using emul-ied asphalt, on the other hand, de-nds upon the ability to get rid of e water. Here rapid evaporation is sirable. The compaction of soils for nbankments can only be carried out ectively when the moisture content at exactly the right percentage for given soil. This amount is usually ferred to as the optimum moisture. hen evaporation rates are very high, can be very difficult, if not impos-le, to maintain enough moisture in soil to insure proper compaction, l if evaporation rates are very low l the soil is wet it may be even re difficult to get rid of the excess ter in order that the soil will mpact.

The removal of water during and llowing construction is mainly by aporation, although some may be orbed by the aggregates. The fac-s influencing evaporation may be

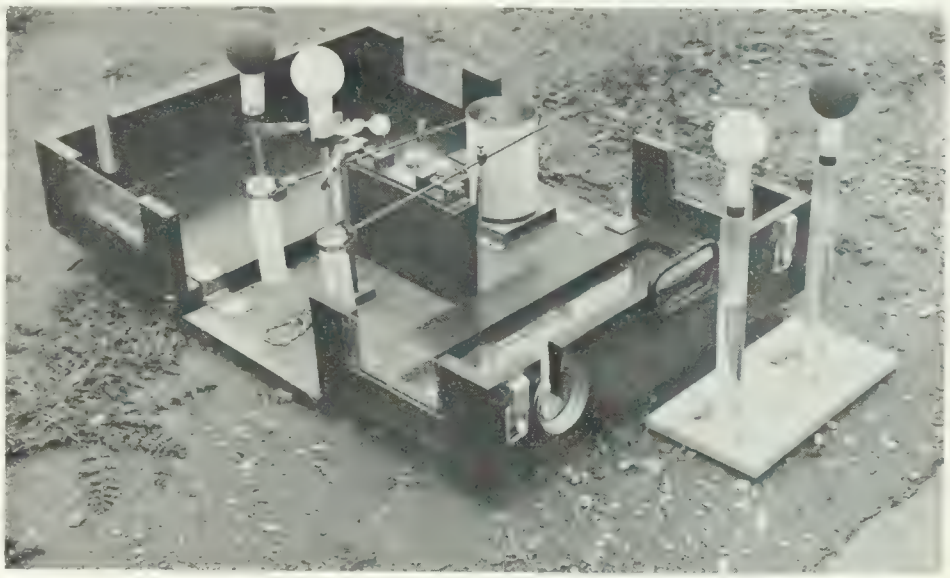


FIGURE 1—Recording unit equipped with porcelain atmometers (left); nonrecording unit (right). During use in the field the recording box unit is closed and only the atmometers exposed.

divided into two groups. The characteristics of the material in which the water is present affects its movement to the surface. These factors are briefly the color, surface area exposed and size of capillaries. The external factors are the humidity, air temperature, intensity of sunlight heating the evaporative surface and the movement or circulation of air over the surface.

Measuring Evaporation

The most commonly known devices for making measurements in this field are usually limited to measuring atmospheric humidity alone. Such devices are the wet-dry bulb thermometers and the sling psychrometer. Many types of hygrometers have also been used. Some of the oldest used human hair which has a very marked tendency to stretch or contract with variations in humidity. None of these devices, however, indicate the total amount of evaporation which would occur as a result of the combined influences of temperature, wind speed and atmospheric humidity.

Any device that provides a measure of the evaporation rate of water is by definition an atmometer. To others, than those engaged in highway construction, the evaporation rate of water is of great interest to physiological ecologists in studies of plant growth. They are responsible for the development of many types of atmometers which include open pans of water, surfaces of wet cloth or paper and porous porcelain pieces of various shapes. Naturally the size and shape of the instrument have an effect on the rate of evaporation and according to authorities the different types are not closely comparable. The most common type is a black or white porous porcelain sphere about 2 inches in diameter enclosed except for an opening of about ¾ inch in diameter. This device is attributed to Dr. Livingston of Johns Hopkins and is generally known as the Livingston atmometer.

Common Method

The most common method of operation is to connect the atmometer, previously filled with distilled water, to a reservoir by means of a glass tube and rubber stoppers. See apparatus on right Figure 1. The reservoir is nor-

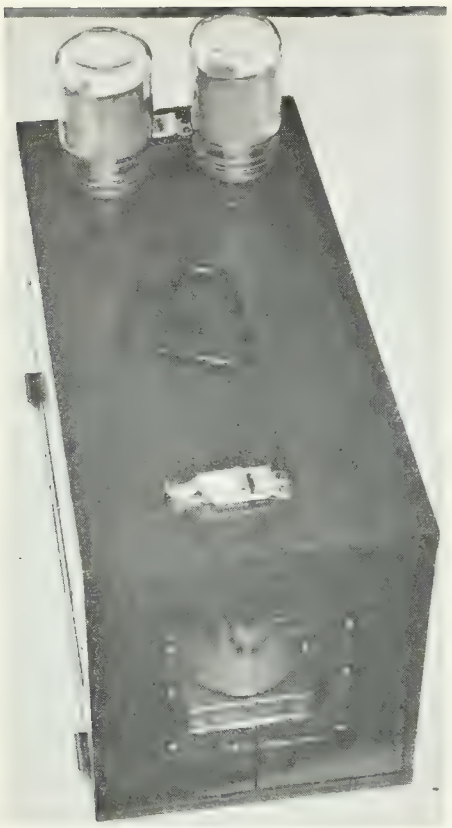


FIGURE 2—Recording unit equipped with porcelain atmometers ready for transportation.

mally a graduated cylinder of 100 ml. capacity. As water evaporates from the outer surfaces of the porous porcelain atmometer, it is replaced by suction from the container. Each unit, as supplied by the manufacturer, has a correction factor based on a previous calibration against a standard unit. This factor must always be used in determining the correct evaporation rate.

The atmometers both white and black were first used by this department about 1935, in connection with evaporation rates from emulsion treated bases. All of our studies from this time to 1957 were made with this spherical type which has the advantage that placement may be made without regard to wind direction. In normal operation the white and black bulbs are placed close together. The black type absorbs more heat and during the daylight hours the evaporation is higher than from the white bulb. On cloudy days or during the night both bulbs show the same evapration rate. In use for highway work one must decide, on the basis of the surface being constructed, which rate most nearly approximates the true condition.

The usual method of measuring the evaporation rate with the Livingston atmometer by means of a graduated cylinder has the disadvantage of requiring a time interval of about one-half hour between readings in order to permit sufficient volume change in the reservoir and furthermore someone must be present to obtain the readings. A further disadvantage is that variations in evaporation rate, during this interval of time, will not be detected. Our initial studies with this apparatus, as applied to seal coat work, convinced us that evaporation rates may vary quite markedly over relatively short periods of time. Therefore, it was decided to design and construct a simple recording device for providing a continuous record of evaporation rate with a minimum of necessary attendance by an observer on the job site.

Apparatus Is Mounted

Such an apparatus is shown in Figures 1, 2 and 3. Each atmometer bulb (A), Figure 3, (only one is shown) together with their supply tubes is mounted in a fixed position by means of support rod (B). The lower end of the supply tube is inserted into a test tube (C), which is supported on a beam (D). The beam is fastened to a support (E) by means of needle point bearings and moves freely in the same manner as a weighing device or balance. A pen (G) which makes a trace on the clock driven cylinder recorder (H) is mounted on the opposite end of the beam. The movement of the beam is partially restrained by a spring (F) which acts as a damping element. The spring allows the operator to control the sensitivity of the apparatus, and from experience an adjustment is made so that the evaporation of 1 ml. of water registers as a spread of 0.10 inch on the recording chart. The instrument with the exception of the bulbs, is enclosed in a case, which prevents wind from interfering with the movements of the beam, Figure 1. It is necessary to soak the units in distilled water before setting them up, in order to force all the air out of the bulbs; also they should be operated for several hours before the start of readings. We have partly solved these problems by placing the entire apparatus in operation in the laboratory several hours before starting for the job site. Just prior to loading, a glass jar, Figure 2, is fitted over each atmometer bulb and screwed into the cap fastened on the case. This provides a dust free chamber for each bulb and also moisture equilibrium is soon established in the chamber so that water ceases to move through the bulbs. By this method the bulbs are saturated with water on arrival on the job site, and after removal of the jars, they rapidly reach equilibrium with their surroundings. This permits reliable readings to be obtained within about 15 minutes after start of operations.

Set Near Road Surface

At the job site the apparatus is set up on the ground as near the road surface as possible, the jars removed, the test tubes refilled with distilled water and the pens are placed on the chart. The hour of start is then recorded and the unit is in operation. Where high evaporation rates are encountered, the water supply must be replaced at least twice each day. This is the only atten-

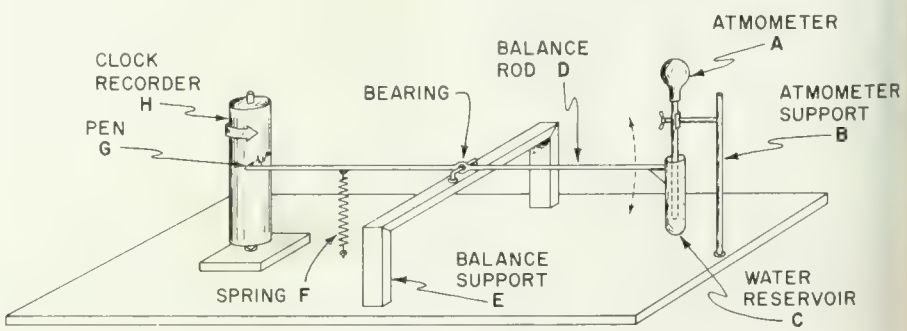


FIGURE 3—Schematic diagram of recording unit for measuring evaporation rate from atmometer bul



FIGURE 4—Filter paper type atmometer.

on necessary in connection with the peration of the instrument.

The total cost of this instrument somewhere around $200 and the evice appears to be sufficiently ac- urate for studies of evaporation rate nder field conditions. Since the evap- ration rate is markedly influenced y local conditions any chart readings ust be applied to relatively short ctions of the road in the vicinity of e instrument. Extreme accuracy is ot necessary for such interpretations d errors caused by evaporation from e open test tube, acting as the sup- y vessel, are very small. A typical st run showed a loss of 0.045 ml/hr om the supply tube compared to an aporation rate of 1.4 ml/hr from e atmometer bulb.

The apparatus can be used for most ld studies with only normal care in nsportation. However, the atmom- ers are rather fragile and must be ndled carefully. Any foreign mate- l which tends to clog the pores will dically change the calibration factor d large errors may result in the final lculated evaporation rate. Distilled ter, not only for the supply vessel, t for all cleaning operations should used. Salts in tap water will quickly llect in the atmometer pores, near e surface, and thus definitely change e calibration factor. Further, such ts are difficult to remove during aning operations.

Dust Is Problem

Another cause of serious error is the slow collection of dust on the outer surface of the bulb. In the laboratory all bulbs are carefully stored in desiccators, when not in active use. Dust is a problem in the field and the bulbs should be protected by bottles when transported or when the unit is not in operation. In any case, immediately after returning from a field trip, all bulbs must be removed and placed in distilled water, and carefully brushed. They are then dried and stored in the desiccator. Even with these precautions, it is necessary to recheck the calibration factor at various times.

The difficulties encountered with the proper care of atmometer bulbs under construction conditions prompted a study of other types of evarporation surfaces. After further study of literature on atmometers, we decided to perform experiments with a paper type. Although some tests had previously been made using paper as the evaporating surface, no satisfactory method of mounting the paper was developed. Using the basic principles described in the literature, the atmometer shown in Figure 4 was developed. This unit uses a heavy 6″ circular filter paper, Eaton-Dikeman grade 652 and the filter paper is clamped in a brass holder. The holder is hollow below the nob so that water may be fed to the paper. This atmometer will handle in excess of 20 ml/hr. in extreme drying conditions.



FIGURE 5—Recording unit equipped with paper atmometer.

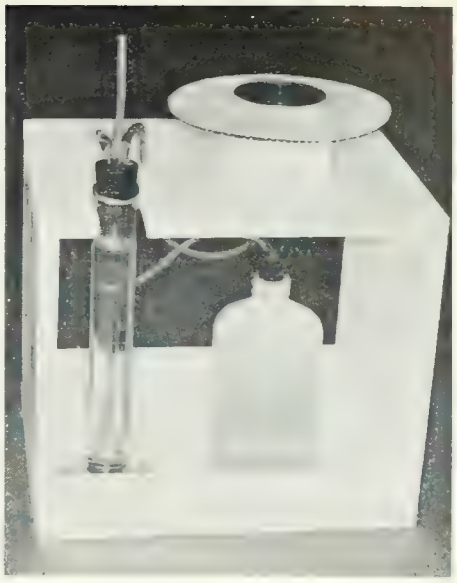


FIGURE 6—Paper atmometer, nonrecording type.

Clockwork Recorder Developed

In conjunction with the paper type atmometer, a clockwork drive recorder was developed. The complete apparatus is shown in Figure 5. Essentially it consists of a small water reservoir of about 125 ml with a ⅛″ diameter hose leading to the paper atmometer. The reservoir is attached to one end of an arm, the opposite end being attached to a horizontal shaft. One carries the recording pen and to the other is attached a spring which is balanced against the weight of the reservoir of water. A 10½″ circular Leeds and Northrup Chart No. 1001 is used. The clockwork drive is a Big Ben type alarm clock with the face and hand replaced by a 10½″ diameter circular aluminum disk to which the chart is attached.

The cost of this instrument is approximately the same as the previously described bulb unit. The advantage of the paper type is mainly that it is very cheap and can be discarded when a coating of dust collects. Also it eliminates the need of using distilled water as required in the porcelain type. This type of recording atmometer is very

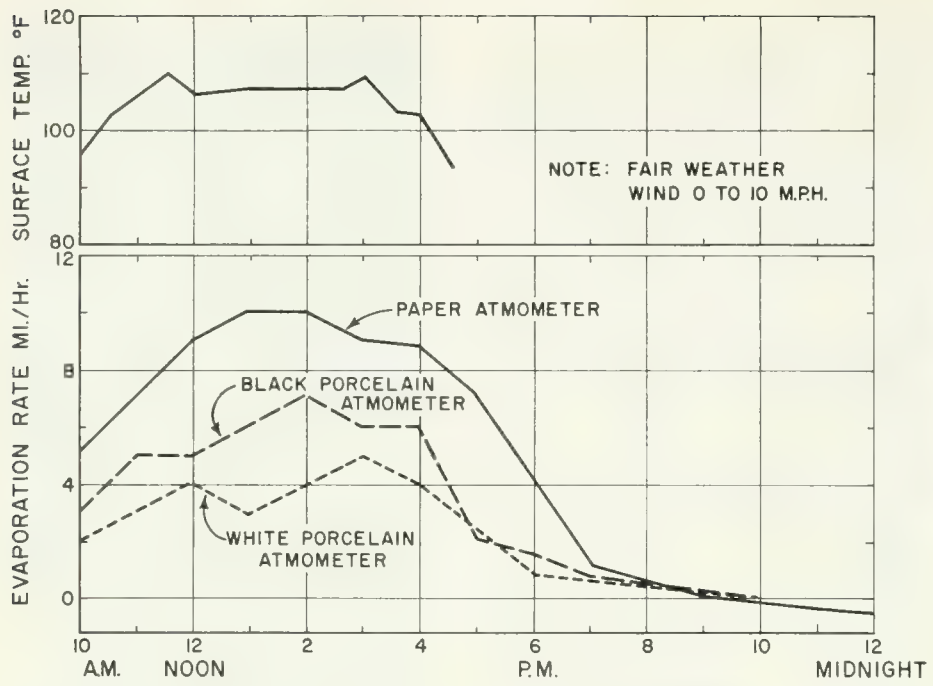


FIGURE 7—Evaporation rates for different types of atmometers.

useful when a continuous record is desired and an attendant is not present to make readings at short intervals.

Occasional Readings

There are many occasions where it might be more desirable to have a greater number of units along the job site and where only occasional readings by an observer are necessary. With this in mind another form of paper atmometer was developed which may be readily moved from place to place and in which the water supply may be easily replenished. The apparatus, shown in Figure 6 costs only about $20, and is easily constructed. It consists of a paper atmometer (6" circular filter paper) which is connected to the 100 ml graduate by a ⅛" hose. The graduate is also connected to a one-pint plastic bottle for a water supply. The graduate is fitted with a rubber stopper having three outlets, the two already mentioned and an air vent.

No Moving Parts

In order to fill the graduate it is merely necessary to squeeze the plastic bottle, and to prime or start the atmometer, the air vent in the graduate is pinched off which forces air out through the paper atmometer, and water into the system and filter paper. Having no moving parts, it can be picked up and moved at any time. Readings are taken at required intervals direct from the glass graduate.

Illustrations of atmometer records from the various types of previously described recorders are shown in Figure 7. It will be noted that the paper atmometer actually absorbed moisture from the air during the night hours. We have also observed this on other occasions when using the porcelain type.

Summary

The primary purpose of this paper is to bring to the attention of highway engineers the importance of evaporation during construction operations and that simple relatively sturdy equipment is available for measuring the evaporation rate.

We have not been able to collect sufficient data from various projects to justify recommendations regarding the possible use of evaporation rate results in connection with compaction, concrete paving and seal coat operations. However, the continued accumulation of such data may provide future useful information to the engineer with respect to one of the natural factors influencing construction operations.

District VII Marks Cass Rose Retirement

Cass M. Rose, office engineer in District VII since 1955, and whose 4(years of engineering experience in cluded 25 years of service with th



CASS M. ROSE

Division of High ways, retired July 6.

Rose was trans ferred from head quarters in Sacra mento to Lo Angeles January 1 1951, to organiz the substructur section and map al underground utilities in the district Later the group took over the proc essing of all minor contracts. H started with the Division of Highway in 1933 as an associate highway en gineer in District I, but left the fol lowing year to become assistant cit engineer in San Francisco. There h set up a program of WPA project In 1935 he returned to the State as a associate highway engineer in Distric IX, where he was on location and con struction assignments, including fou years as resident engineer in Mojav

From 1941 to 1944 Rose was civilian engineer with the U.S. Navy acting as chief inspector at the Mar Island Navy Yard, Kearny Mesa Ai Field and Litchfield Air Field. At th conclusion of this service he returne to the State and was assigned to Dis trict I. From 1947 until he transferre to District VII he was in Sacrament in the headquarters survey and plar department (now design).

Rose's engineering experience bega in 1911 when he got a job with survey party. During the next 21 yea he worked for railroads in Nort Dakota, Montana, South Dakota, Mir nesota and Illinois, and for the high way commissions in Minnesota, Sout Dakota and Iowa. During World W I, from 1917 to 1919, he served in th U.S. Army with the 13th Enginee in the American Expeditionary Forc and in the First Division in German with the Army of Occupation.

Safety Foundation Marks 25th Birthday

The Automotive Safety Foundation, a nonprofit organization dedicated to safe and efficient highway transportation, observed its 25th anniversary June 2.

ASF was founded by the automotive industry in 1937 during the early years of mass highway travel, a period marked by drastic increases in traffic volumes and a corresponding rise in fatalities, injuries and property destruction.

Its program is financed through the voluntary contributions of more than 500 companies and industry associations which have invested a total $25 million in ASF as a service to the motoring public and the United States' economy.

The results have revolutionized highway transportation. The traffic death rate of 15.1 per 100 million miles of travel in 1936 has been reduced to 5.2, making highway travel on a mileage basis nearly three times safer than a quarter century ago.

ASF's highway engineers drafted the nationally accepted techniques for determining future highway needs and have conducted 35 highway studies in 27 states, including two in California, covering more than half of the nation's road mileage. These studies paved the way for innumerable highway improvement programs, including the 41,000-mile national system of interstate and defense highways, which alone is expected to save 30,000 lives when completed in about 20 years.

The highway engineering staff is now giving increased assistance to states in programing road projects according to urgency and in improving road management procedures. A study of this nature is underway in Washington.

With highway agencies expecting to spend more than $125 billion in the next 10 years, ASF anticipates that the program will become an important contribution to efficient highway development.

Traffic engineers on the ASF staff have assisted 41 major cities in developing more effective methods for traffic control and are now stepping up research for solutions to urban transportation problems.

ASF awards grants of funds to universities and public service groups for specific research and educational projects, provides technical services to government officials and agencies.

DEPARTMENT ANNOUNCES RECENT RETIREMENTS

District I

Cyril F. Collins, Highway Foreman, 35 years; Harry D. Hicker, Highway Bridge Maintenance Foreman, 28 years; Theodore W. Maxwell, Highway Maintenance Man II, 28 years; Joe O'Connell, Highway Maintenance Man I, 26 years.

District II

Rolin M. Eslinger, Highway Maintenance Man III, 33 years.

District III

Daniel D. Breuning, Highway Superintendent, 45 years; Paul W. Gruenhagen, Drawbridge Operator, 28 years; Marion Raugust, Assistant Highway Engineer, 9 years.

District IV

Hugh F. MacKenzie, Assistant Highway Engineer, 29 years; Edward V. Metcalf, Junior Typist-Clerk, 10 years.

District V

Stephen G. Jaeger, Highway Maintenance Man II, 23 years; William C. Mitchell, Highway Maintenance Man I, 15 years; Victor E. Pearson, Associate Highway Engineer, 34 years.

District VI

Samuel H. Black, Highway Foreman, 36 years; * Carlton V. Hadley, Highway Field Office Assistant, 6 years.

District VII

Henry E. Cowan, Highway Maintenance Man II, 28 years; Drew J. Faulkner, Associate Highway Engineer, 29 years; Paul E. Holbrook, Highway Field Office Assistant, 6 years; Hugh H. Powell, Highway Maintenance Man II, 24 years; Loral Wiley, Highway Maintenance Man II, 28 years.

District VIII

* Rex E. McKinney, Highway Engineering Technician I, 7 years.

District IX

Albert Radley, Highway Maintenance Man I, 29 years.

District X

William D. Haigh, Highway Foreman, 36 years; Ben J. Harrigan, Drawbridge Operator, 29 years; Otis W. Holland, Drawbridge Operator, 13 years; Manuel G. Maciel, Drawbridge Operator, 29 years; Emery C. Nelson, Associate Right of Way Agent, 8 years.

District XI

Landon W. Cope, Highway Foreman, 38 years; Austin C. Erwin, Highway Foreman, 28 years; Edward L. Reiner, Laborer, 14 years.

Headquarters Office

Harold B. LaForge, Principal Highway Engineer, 45 years; Tom W. Reynolds, Senior Highway Engineer, 28 years.

Bridge Department

Charles C. Darden, Highway Field Office Assistant, 7 years.

State-owned Toll Bridges

Katie F. Carpenter, Telephone Operator, NMB, 17 years; Howard C. Wood, Principal Bridge Engineer, 33 years.

Materials and Research Department

George C. Nickel, Skilled Laborer, 11 years; Arthur W. Root, Supervising Materials and Research Engineer, 9 years.

Headquarters Shop

James J. Keleher, Associate Equipment Engineer, 31 years.

Shop 5

Norman N. Weber, Automobile Mechanic, 34 years.

Shop 7

John L. Jackson, Senior Machine Parts Storekeeper, 14 years.

* Disability retirement.

Equipment and Shops Lose Three Veterans

Three veteran employees of the State Division of Highways Equipment Department have retired from state service.

They are Frank F. Green, Senior Equipment Engineer, 30 years of service; Homer T. Forschler, General Superintendent of Shops, 40 years of service; and Albert C. Briney, Associate Equipment Engineer, 33 years of service.


FRANK F. GREEN

Green joined the equipment department in 1931 as superintendent of the Bishop shop. In 1933 he transferred to Fresno. In 1943, he became superintendent of the Redding shop, and in 1947 was transferred to San Francisco. His career at equipment department headquarters began in 1950 when he became superintendent of the department's Sacramento shop. In 1952 he was promoted to senior equipment engineer in charge of operations at the equipment department.

Green and his wife, Hermione, have a daughter, Daphne, in Sacramento and a son, Maurice, in Fresno.

Forschler started his career with the Division of Highways in 1921 as a truck driver in Modoc County. In 1942 he was promoted to highway mechanic foreman in the Redding shop. In 1947 he became superintendent. His career brought him to Sacramento in 1954 as general superintendent of all highway shops which cover the entire State.


HOMER T. FORSCHLER

Forschler and his wife, Mabel, live in Sacramento.

Briney joined the California Division of Highways in 1928 as a draftsman in Redding. His career has taken him all through the northern and eastern part of the State as a resident engineer on various construction projects. In 1937 he was called to the Sacramento headquarters office where he worked in the highways specification section. In 1952 he transferred to the equipment department where he has been the office engineer and in charge of contracts for building and lands maintenance, and industrial safety promotion.


ALBERT C. BRINEY

Briney and his wife, Nina, have a son, Robert, an associate bridge engineer with the Division of Highways in Los Angeles, and three grandchildren.

IN MEMORIAM

District I

George L. Linton, Highway Maintenance Man II

District IV

Ted L. Reeves, Tree Trimmer

District VII

Jose T. Alvarez, Supervising Groundsman I

Giles H. Lamb, Jr., Senior Highway Engineer

Richard Q. Park, Highway Maintenance Man III

Jack E. Worley, Assistant Highway Engineer

District VIII

David R. Henderson, Highway Maintenance Man III

Molly M. Price, Senior Stenographer

Headquarters Office

Donald Alen Baugh, Senior Clerk

Melbourne H. West, Principal Highway Engineer

Bridge Department

Charles W. DuBois, Delineator

Materials and Research Department

Anna L. Vairo, Intermediate Stenographer

TWENTY-FIVE-YEAR LIST

The following employees received 25-year awards during May and June:

District I

Luther Goodlin
Glenn R. Wooldridge

District II

William R. Borden

District III

Francis W. Fox
Lester J. Koster

District IV

Burnell C. Kahn
Leslie M. Petersen

District V

Helen Rutherford

District VI

Robert Lee Bradley
Joseph H. Jensen
Detmer F. Landreth

District VII

Jack E. Eckhardt

District VIII

Earl W. Ary

District X

Bruno Dentino
Walter H. Mariotti

Headquarters Office

Paul E. Billings
John L. Elia
Howard H. Hoover
Margaret Long
Charles M. Zeitler

Bridge Department

Winfield C. Names
Bing Q. Wong

State-owned Toll Bridges

Carl H. Waters

Headquarters Shop

Roydon S. Lynn

Shop 7

Edwin H. Hanks

Richard H. Ramsey Retires in Eureka

Richard H. Ramsey, district right-of-way agent of District I, Division of Highways, was guest of honor at a retirement dinner on June 29 in Eureka, marking his retirement after more than 26 years of service with the State of California.

Ramsey's career of public service has included, in addition to his service with the State, a two-year term as auditor and controller for the State of Arizona. He served as district right-of-way agent of District I since April 1945.

His career with the State began in 1936 when he joined the District III office in Marysville. In August of 1938 he transferred to the office in Eureka, where he has guided the growth of his department from a section of two agents and one secretary to a present staff of 50 employees.

Ramsey is an active member of the Ingomar Club, the American Right of Way Association, and the Christ Episcopal Church of Eureka. He has been active in the California State Employees' Association for many years and served as its regional director in 1944.



R. H. RAMSEY

Before entering state service, he held banking positions in Yuma, Arizona, and Imperial, California.

He was born on a farm near the town of Cleburne, Texas, and started work in 1914 in the Traders State Bank there. He moved to Arizona in 1915 and worked for the next 10 years in the banking business, interrupted in 1922 by election to a two-year term as state auditor and controller. He returned to the banking business until 1927, when he moved to San Diego and associated with a firm handling municipal bonds and other securities.

William A. Sloane has been transferred from the Stockton District Office of the Division of Highways and promoted to district right-of-way agent to fill the vacated position, according to an announcement by Sam Helwer, District Engineer.

DIVISION EXHIBITS PUBLICATIONS AT STATE LIBRARY



As part of a special program developed by the State Library in Sacramento to feature publications of various state agencies, during June and July. The Division of Highways placed an exhibit of its publications just outside the Government Publications Section on the third floor of the library building. Shown posing with the exhibit are, left to right, Mary E. Schell, Supervising Librarian, Government Publications Section; Ruth Elwonger, California State Publications Librarian; and Martin E. Thomas, Assistant Supervising Librarian, Government Publications Section.

L. A. SUPERINTENDENT A. A. HILTON RETIRES

Albert A. Hilton, Highway Equipment Superintendent for the Division of Highways at its Shop 7 in North Hollywood, retired on July 1. He had been with the State 41 years.

Hilton began his service as a mechanic in District VII in the summer of 1921. He became a foreman in 1931 and was promoted to highway equipment superintendent I and transferred to Shop 8 (San Bernardino) in 1942. He was assigned to Shop 4 (San Francisco) as superintendent II in 1954 and transferred back to Los Angeles two years later.



ALBERT A. HILTON

A native of Connecticut, Hilton came to California in 1921.

Hilton is a dog fancier. He owned and operated kennels in North Hollywood from 1930 to 1942. One of his late champion Great Danes, Ch. Sunswept Alecto, holds a "best of breed" win over the largest entry of Great Danes on record.

Hilton and his wife, Marguerite, have three daughters: Mrs. William Foshee, now in Hahn, Germany; Mrs. Eunice Shepherd, North Hollywood; Mrs. Donald L. Campbell, Rialto.

The Hiltons will divide their time between their two homes, one in Westwood, Lassen County, and the other in the San Fernando Valley.

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

HIGHWAY TRANSPORTATION AGENCY

ROBERT B. BRADFORD . . . Administrator

DEPARTMENT OF PUBLIC WORKS . . . ROBERT B. BRADFORD, Director

FRANK A. CHAMBERS . . . . Chief Deputy Director

RUSSELL J. COONEY . Deputy Director (Management)
HARRY D. FREEMAN . . Deputy Director (Planning)
T. F. BAGSHAW . . . . . Assistant Director
JOHN H. STANFORD . . . . . Assistant Director
JUSTIN DuCRAY . Departmental Management Analy
S. ALAN WHITE . . Departmental Personnel Offic

DIVISION OF HIGHWAYS

J. C. WOMACK . . . State Highway Engineer, Chief of Division

CHAS. E. WAITE . . . Deputy State Highway Engineer
J. P. MURPHY . . . Deputy State Highway Engineer
J. A. LEGARRA . . Deputy State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
GEO. LANGSNER . . Assistant State Highway Engineer
FRANK E. BAXTER . Assistant State Highway Engineer
J. C. BURRILL . . . . . Comptroller
C. G. BEER . . . . . Urban Planner
L. L. FUNK . . . . . Planning Engineer
MILTON HARRIS . . . . . Construction Engineer
F. N. HVEEM . . . Materials and Research Engineer
SCOTT H. LATHROP . Personnel and Public Information
C. T. LEDDEN . . City and County Projects Engineer
H. C. McCARTY . . . . . Office Engineer
A. M. NASH . . . . . Systems Research Engineer
E. J. L. PETERSON . . Program and Budget Engineer
F. M. REYNOLDS . . . . Planning Survey Engineer
EARL E. SORENSON . . . . . Equipment Engineer
E. L. TINNEY . . . . . Maintenance Engineer
W. L. WARREN . . . . . Engineer of Design
G. M. WEBB . . . . . Traffic Engineer
A. L. ELLIOTT . . . . Bridge Engineer—Planning
L. C. HOLLISTER . Bridge Engineer—Special Projects
I. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area

Right-of-Way

RUDOLF HESS . . . . . Chief Right-of-Way Agent
DEXTER D. MacBRIDE . . . . . Assistant Chief
RAY E. O'BIER . . . . . Assistant Chief
R. S. J. PIANEZZI . . . . . Assistant Chief
JACQUES T. ZEEMAN . . . . . Assistant Chief

District I, Eureka

SAM HELWER . . . . . District Engineer

District II, Redding

H. S. MILES . . . . . District Engineer

District III, Marysville

ALAN S. HART . . Assistant State Highway Engineer

District IV, San Francisco

J. P. SINCLAIR . . Assistant State Highway Engineer
L. A. WEYMOUTH . . . . . District Engineer
R. A. HAYLER . . . . . District Engineer
HAIG AYANIAN . . . . . District Engineer

District V, San Luis Obispo

E. R. FOLEY . . . . . District Engineer

District VI, Fresno

W. L. WELCH . . . . . District Engineer

District VII, Los Angeles

E. T. TELFORD . . . Metropolitan District Engineer
A. L. HIMELHOCH . . . . . District Engineer
GEORGE A. HILL . . . . . District Engineer
A. C. BIRNIE . . . . . District Engineer
A. W. HOY . . . . . District Engineer

CALIFORNIA HIGHWAY COMMISSION

ROBERT B. BRADFORD . Chairman and Director of Public Works
ARTHUR T. LUDDY . . Vice Chairman Sacramento
JAMES A. GUTHRIE . . San Bernardino
ROGER S. WOOLLEY . . . San Diego
JOHN ERRECA . . . . . Los Banos
ABRAHAM KOFMAN . . . San Jose
FRANKLIN S. PAYNE . . Los Angeles
JACK COOPER, Secretary . . . Sacramento

District VIII, San Bernardino

C. V. KANE . . . . . District Engine

District IX, Bishop

C. A. SHERVINGTON . . . . . District Engine

District X, Stockton

JOHN G. MEYER . . . . . District Engine

District XI, San Diego

JACOB DEKEMA . . Assistant State Highway Engine

State-owned Toll Bridges

CHARLES L. SWEET . . . . . Bridge Engine

DIVISION OF CONTRACTS AND RIGHTS-OF-WAY (LEGAL)

ROBERT E. REED . . . . . Chief Counsel

GEORGE C. HADLEY . . . . . Assistant Chief
HOLLOWAY JONES . . . . . Assistant Chief
HARRY S. FENTON . . . . . Assistant Ch

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

NORMAN C. RAAB . . . . Chief of Division
BEN BALALA . . . . . Principal Bridge Engineer

DIVISION OF ARCHITECTURE

EARL W. HAMPTON . . . Acting State Architect, Chief of Division

EARL W. HAMPTON . . . . Deputy Chief, Architecture and Engineering
HUBERT S. HUNTER . . . . . Deputy Chief, Administrative
ARTHUR F. DUDMAN . . . . . Assistant State Architect (Nor
TOM MERET . . . . . Assistant State Architect (Sou
CHARLES M. HERD . . . . . Chief Construction Engineer

DIVISION OF AERONAUTICS

CLYDE P. BARNETT . . . . . Director, Chief of Division

Printed in Calif. . . . by State Printing Office . . . 67550 7 62 45 y



st year's 50th anniversary feature showing the first permanent Highway Commission reminded Mr. Theodore R. Mini of Glendale of the above photo in his ossession. Pictured is the Number One Survey Party working in 1911 on survey of El Camino Real in San Mateo County, one of the state routes authorized in e Highway Act of 1909. From left to right the men in the photograph are Willis G. Frost, chief of party, now a consulting engineer at Redwood City; William Sharp, chainman; Mr. Mini, instrumentman, now a consulting engineer; Robert A. Sinclair, chainman; and O. M. Moll, stakeman and driver.

The Good Road Builder First Surveys the Route; He Starts From Somewhere to Go Somewhere; He Shows How It Is Done; He Makes Traveling Easier for Others.—(From masthead of *California Highway Bulletin*, Volume I, Number 1, October 15, 1912.)

Fifty years ago, in the summer of 912, the first contract was let to uild a California state highway sys- m as required by the State High- ays Act of 1909. Roads already isted, of course, but they were ecemeal efforts of the various coun- es in most cases. Often they petered it, or became rough wagon tracks hen they crossed a county line.

The 1909 act provided for a bond sue of $18,000,000 to provide a state ghway system of about 2,600 miles, system for which the growing num- r of automobile owners had been ciferously clamoring. Hence, when ork started on Contract Number ne of the system, in San Mateo unty, it was not only big local ws, but also big news statewide.

A fund of $18,000,000 for paving d surfacing 2,600 miles seems ridic- usly small today, but money went rther in 1912. Contract Number ne, 5.4 miles in length, asphalt sur- ce on portland cement concrete se, 24 feet wide, was bid at a cost approximately $17,000 a mile. This as a major route, and expensive.

Work on El Camino Real near Burlingame, 1912.



California Highways and Public Works
DIVISION OF HIGHWAYS
P O Box 1499
SACRAMENTO, CALIFORNIA

RETURN POSTAGE GUARANTEED

SEATTLE PUBLIC LIBRARY
4TH & MADISON
SEATTLE 4, WASHINGTON

R56

BULK RATE
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152



FILE IN STACK

CALIFORNIA

Highways and Public Works

Seattle Public Library
NOV 23 1962



SEPTEMBER–OCTOBER
1962

Highway Program Featured in Two Articles

The California Highway Commission and the Division of Highways were the subjects of two feature articles appearing in automobile club periodicals recently.

The problems and procedures of the Highway Commission are explained in "Freeway Routes and the Highway Commission" appearing in the August 1962 issue (Part 2) of *Auto Club News Pictorial*, published by the Automobile Club of Southern California.

While recognizing the inevitability of disagreement over freeway routes, the article points out that of "511 miles of freeway routes adopted (by the commission) in 1961, only 65 miles involved controversy of any appreciable degree."

Many of these problems, the article says, are due to lack of understanding of the State's freeway program coupled with the natural tendency to resist change if that change appears to be that it is going to be disruptive.

The article then lists some of these normal fears and explains why they seldom materialize. They are:

"Chinese Wall." (Actually, enough over and under crossings and interchanges are provided not only to handle local traffic but to make such cross traffic movement much safer than before.)

"Land Removed From Tax Rolls." (In most instances, the displaced owners will relocate in the same general area in a facility of higher valuation. Secondary additional benefits occur in the form of stimulus to construction and a general upgrading of the community.)

"Decrease in Land Values." (Economic studies have proved beyond a doubt that construction of a freeway in a community raises land market values.)

"Freeways Are Unsightly." (Landscaping is now an integral part of freeway design. "One needs only to fly over one of our urban areas to observe that in many neighborhoods the only green belt in view are the freeways.")

"Loss of Parks." (This is avoided where possible but where park property provides the only economical route, the amount of property acquired is held to a minimum, often replaced in kind and extra pains taken to blend the freeway with the landscape.)

The planning, design, construction and maintenance of state highways are all dealt with in an inclusive article appearing in the September-October 1962 issue of *Motorland*, official magazine of the California State Automobile Association.

The change in transportation ease and speed is dramatically set forth at the beginning of the article by comparison of an excerpt from a 1909 motorist's diary of a 6-day, 83-mile trip rife with blowouts, broken axles and rims and muddy roads and the terse entry of a 1962 motorist who left San Jose at 7 a.m. on a business trip and arrived without incident in Sacramento 2½ hours later.

After calling attention to the current freeway system throughout the State, the article gives a step-by-step account of how a freeway route is adopted, designed and constructed, stressing the co-operation between local communities and state authorities which has made the present freeway and expressway network possible.

There are now 2,425 miles of multilane divided highways in the State of which 1,000 miles are full freeway, the article points out. Another 400 miles of freeway are under construction.

However, within the next 20 years California's traffic load is expected to more than double.

"Despite the enormous challenges of building highways adequate to the needs of the future," the article concludes, "the California Division of Highways is moving ahead, confident that the State's master plan for highways will enable motor vehicle traffic to flow smoothly and safely."

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

Vol. 41 September-October 1962 Nos. 9-10



FRONT COVER—Children watch freeway traffic from the Turnbridge Drive pedestrian overcrossing on U.S. 50–99 south of Sacramento. See "Kidproof Railings" beginning on page 19. Photo by John Meyerpeter.

BACK COVER—Looking west along construction on the Ventura Freeway from above Telephone Road in the City of Ventura. Sign Route 126 joins the new freeway at the bend (right center). See "Ventura County Freeways" beginning on page 36. Photo by Robert Rose.



CONTENTS

Page

Bridge Opening ... 2

Last Ferry ... 5
By J. J. Teuscher, Administrative Section, District X

Redlands Freeway ... 7
By W. H. Crawford, District Construction Engineer

Freeways and Cities ... 13

Traffic Relief ... 16
By Heinz Heckeroth, Executive Assistant, District VII

Kidproof Railings ... 19
By A. L. Elliott, Bridge Engineer, Planning

Slip-form Job—Fresno ... 24
By N. E. Humiston, Resident Engineer

Two-county Link ... 28
By Newton E. Templin, Road Commissioner

Fortuna Project ... 31
By E. B. Thomas, Senior Highway Engineer

Ventura County Freeways ... 36
By E. T. Telford, Metropolitan District Highway Engineer

Traffic Stripes ... 47

6,240 Miles ... 49

Bradford Is Speaker at 30th Annual A.B.T.T.A. Meeting 50

Federal Aid—'51 to '62 ... 51
By G. G. McGinness, Assistant Office Engineer

San Diego-Coronado Crossing ... 58

Nash Retirement Brings Staff Changes ... 59

Funds Are Allocated to Cut Road Deaths ... 59

Folkins Is Champion Lawn Bowler of World ... 60

Funds Allocated for Prehistoric Salvage ... 60

Initial Funds for Sign Route 152 Relocation ... 62

Twenty-five-year Awards ... 63

Retirements
- N. R. Bangert ... 62
- George R. Barry ... 62
- Leland T. Crane ... 63
- Milton Harris ... 61
- M. R. 'Mique' Nelson ... 59
- Burnell Van Dalsem ... 60
- Department List ... 61

Obituaries
- Spencer Cortelyou 46
- In Memoriam ... 63

LESTER S. KORITZ, *Editor*

STEWART MITCHELL, *Associate Editor* JOHN C. ROBINSON, *Associate Editor*

WILLIAM R. CHANEY, *Chief Photographer*

Editors are invited to use information contained herein and to request prints of any black and white photographs.

Address communications to: EDITOR,

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

P. O. Box 1499

SACRAMENTO, CALIFORNIA

Bridge Opening

New Span Joins Benicia, Martinez; Ends 115-year-old Ferry Service

On September 15, the Benicia-Martinez Toll Bridge was opened to traffic.

Governor Edmund G. Brown's official proclamation of this fact delivered from the deck of the ferryboat *Carquinez* below the bridge at the stroke of noon, was followed by a blast of horns and whistles, the cheers of spectators and a cloud of released balloons and homing pigeons.

A flight of delta-winged Air Force jets swooped overhead a few moments later and, as if to complete the scene, a gray military transport chose at that moment to slip beneath the central span of the structure.

Throughout the day, parades, picnics, street dancing and sport events took place in Benicia and Martinez. All auto traffic was allowed toll free over the bridge until midnight of the first day.

Thus, after three years under construction, the new $27,500,000, 6,215-foot bridge and its freeway approaches were officially opened, carrying State Sign Route 21 across the Carquinez Straits.

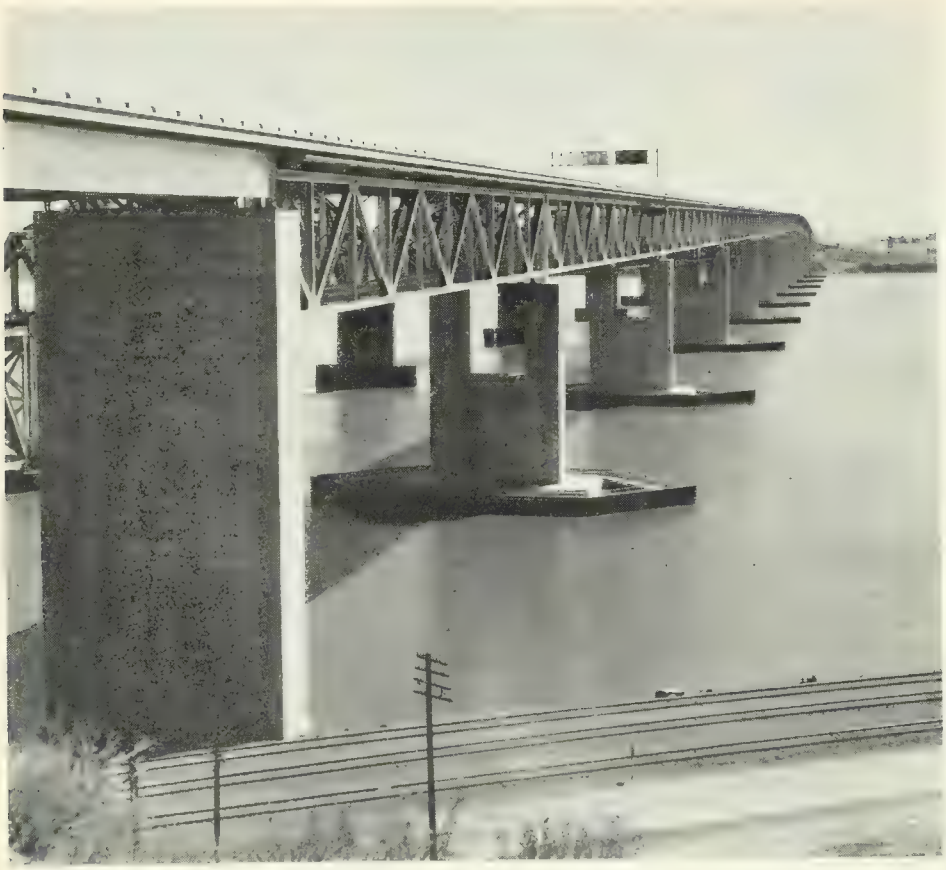
There was also a sad note to the ceremony. It marked the last voyage between Benicia and Martinez of the



Governor Edmund G. Brown, behind the microphones (center), announces the Benicia-Martinez Bridge to be officially opened as released American and Stat Flags rise into the air borne by balloons.



An aerial of the new Benicia-Martinez Bridge taken a few days after it was opened to traffic. The view is southward toward the City of Martinez in the distance.



The new bridge has a vertical clearance of 138 feet above the water and is 6,215 feet long. This photo is looking south from the Benicia side.



The freeway approach to the bridge at the Martinez end, looking north toward the bridge visible in the background.

Motor Vessel *Carquinez* and the end of the oldest ferry service in the Bay area, which had been in operation for 115 years. (See "Last Ferry" on page 5.)

Long envisioned by civic and state officials and highway planners, the new bridge is another important link in the interstate highway system and will provide an outlet to the north for one of the fastest growing areas in California. It provides a direct connection to the Sacramento Valley and points east and north for cities such as Martinez, Concord, Walnut Creek, Dublin and San Jose, as well as metropolitan Oakland.

As a section of Interstate Route 680, it also constitutes a key link in the circumferential freeway route around the San Francisco Bay area which includes U.S. 40 and the proposed Junipero Serra Freeway on the Peninsula.

Constructing of the bridge was made possible by the Legislature in 1955 when it authorized the California Toll Bridge Authority to issue $80 million in bonds to finance a second parallel Carquinez Bridge and the Benicia-Martinez Bridge.

The second Carquinez Bridge was completed in November 1958. First contract on the Benicia-Martinez Project was awarded in August 1959.

The Benicia-Martinez Bridge has four lanes of traffic with a 10-foot-wide median separating opposing lanes.

It has a 138-foot vertical clearance for navigation.

Some novel money- and time-saving methods were used in construction of the bridge. For example, the concrete pier footings were built on shore, floated into place, anchored and sunk into position.

The concrete piers were constructed by the new slipform method, a 24-hour continuous operation in which the form was jacked up at the rate of about 10 inches an hour until the 100- to 130-foot-high stems were completed.

The major contracts in the construction of the bridge were a $5,769,000 contract for the substructure and an $8,469,000 contract for the superstructure, both awarded in August 1959.

Last Ferry

Benicia-Martinez Service Ends After Opening of New Toll Bridge

By J. J. TEUSCHER, Administrative Section, District X

On September 15, 1962, the Benicia-Martinez Ferry made its last trip across the Carquinez Straits. This date marked not only the end of the state-operated ferry system, but also the end of 115 years of ferry service in the San Francisco Bay area (except for a new Tiburon commuter vessel). On that date the new Benicia-Martinez Bridge was opened to the public.

In 1847 General M. G. Vallejo deeded a portion of his holdings on the Carquinez Straits to Dr. Robert Semple and Mr. Thomas O. Larkin for $100 on the condition that (1) the city to be established there be called either Francisca or Benicia, and (2) that a ferry be established to belong to Robert Semple until 100 families lived in the town—then the proceeds were to be devoted to the public schools.

General Vallejo's stipulations were immediately carried out. The town was named Francisca (shortly to be renamed Benicia) and a ferry was put into operation. The first ferry was a scow built by Charles Heath for Dr. Semple. Since the currents in the Carquinez Straits were very strong, the ferry would usually end up down-

The *M.V. Carquinez* has been sold to the State of Florida for $86,001. It will be used as a part of the State of Florida's ferry system across the mouth of the St. Johns River on the Atlantic Coast east of Jacksonville.



The "Carquinez" makes one of her last runs across the strait between Martinez and Benicia.

stream some distance from Benicia forcing the customers to walk back to the town. The second ferry was a sloop-rigged vessel with a green bow and long protruding horns (appropriately named the *Green Horn*). The second ferry improved on the service by landing not so far downstream.

Rate for Horses

Of interest is the following item in the July 31, 1847, issue of the *Californian* published at San Francisco:

"*Ferry at Benicia City*

In establishing the rates of ferriage across the Bay, I have reference to the gentle horses which might be led onto the boat. But as wild horses and mares have to be hauled in, I have been under the necessity of charging fifty cents each, more than for tame horses."

Preceding this appearance of this article an event of note took place during a routine crossing of the straits. A sudden squall appeared, causing the boat to pitch. Some of the horses became alarmed and started to kick. Part of the boat gave way, plunging the horses into the water. Many were drowned while some others reached shore. Among the ones that reached land was General Vallejo's prize white mare. General Vallejo promptly called the island on which she landed, "Isla de la Yegua" or "Mare Island."

With gold excitement at its height in 1849, Semple's ferry became a very profitable enterprise. He averaged $50 a day even though he had to operate the ferry by himself—his help had taken off for the gold fields. He was offered $3-$5 per man to cross the straits and had up to 30 customers waiting at a time.

First Steam Ferry

In the early 1850's, Captain O. C. Coffin operated the first steam ferryboat across the straits. He later built this up to three boats and continued operation until the Central Pacific Railroad built its train carrying ferries. Also in the early 1850's, Semple had constructed a steam ferryboat which he named the *Colusa*. The steam engines for the boat were not of the same size, but with cogwheels and other necessary parts, the men thought they had the powers of the engines equalized. As the boat started to move, the larger engine overpowered the smaller one, thus moving the boat in a wide circle. The mechanical difficulties were soon corrected and the boat proceeded to Colusa. Her first trip was her last—the engines were disposed of and she was converted to a barge.

When the Central Pacific Railroad put into operation its two huge ferries in 1879, the railroad distance between Sacramento and San Francisco was reduced by 60 miles. These two ferries, the *Solano* and the *Port Costa* were the largest in the world. The *Solano*, carrying both passenger and freight trains, was 420 feet long, 116 feet wide, and 17 feet high. It had a displacement of 5,450 tons and could carry 2 locomotives and 24 passenger cars or 2 locomotives and 36 freight cars. The *Contra Costa* was added to the service in 1914. It was 13 feet longer and 2 feet higher than the *Solano* and had a displacement of 7,198 tons.

Funds Provided

When Captain Coffin was forced to give up his ferry line between Benicia and Martinez due to railroad competition, the two towns were without a direct connection until the State Legislature provided funds for connecting the several county seats with state highways. State Sign Route 21 was entitled to some of these funds as it connected the county seats of Fairfield, Oakland, San Jose and Martinez.

In 1915 the Martinez-Benicia Ferry Company operated the paddle-wheel boat *City of Seattle* (built in 1888). It was operated until 1943 until taken over by the U.S. Navy for use between Mare Island and Vallejo. The company built the *City of Martinez* in 1917, which was used until 1929 when it was replaced by the *Issaquah*.

The American Toll Bridge Company took over the ferry system in 1929 and operated it until 1939 when the State of California bought the Carquinez and Antioch Bridges and announced that it would no longer operate the ferry, as traffic would be diverted across these two bridges. Objections were raised to this plan so the ferry was offered to Solano and Contra Costa Counties, the Cities of Benicia and Martinez, and to the ferry employees, in that order. Subsequently the ferry system became the property of the City of Martinez.

Ferries Traded

The City of Martinez traded the *Issaquah* for the *Charles Van Damme* and also acquired the *City of San Rafael* from the government. After World War II the *Charles Van Damme* was tied up and the *City of San Rafael* became the regular ferry. With the condemnation of the *City of San Rafael* in 1953, the year the State of California took over the ferry as part of the state highway system, the *Charles Van Damme* was the only ferry in operation across the Carquinez Straits. In 1955 the *Charles Van Damme* was damaged and subsequently condemned.

From early in 1955 to late in 1956 the only ferry between Benicia and Martinez was a passenger ferry. In November 1956 the *Carquinez* was built and placed in service until the cessation of ferry operation September 15, 1962.

It is estimated that more than 4 million vehicles have crossed the Carquinez Straits between Benicia and Martinez since the system started. It is not possible to estimate the number of individual passengers who have made the crossing but the figure would undoubtedly exceed 6 million for the 115 years of operation.

NOTE: The author is indebted for many of the historical facts in this article to LeNoir Miller's "Railroad Ferry Days" in the Benicia Arsenal Magazine, March 1951, and to Jacqueline McGart Woodruff's book *Benicia—the Promise of California*, 1947.

EMPLOYEES REASSIGNED

All 24 of the men employed on the Benicia-Martinez Ferry which discontinued operation on September 15 have been offered other jobs with the State Division of Highways, and 19 of them have accepted.

Personnel Officer Marian Smith of the division said that as a result of several months of conferences between highway officials at the Stockton district office and the ferry employees, jobs were located for the 19 who were interested. Of the remaining five, two are retiring from state service and three have resigned for other employment.

After the shutdown of the ferry service the men will transfer to jobs as drawbridge operators, Sacramento Delta ferry operators, or highway maintenance men (two of them on the new toll bridge).

Redlands Freeway

New $16,000,000 Project Serves Local, Interstate Traffic

By W. H. CRAWFORD, District Construction Engineer



Completion of two large-scale projects for freeway construction by Matich Constructors and W. F. Maxwell Company; and Fredericksen & Kasler and Gordon H. Ball, Inc., have ended continuing traffic problems on U.S. 70-99 through the Redlands–Loma Linda area.

Weekend peak flows between the Los Angeles metropolitan area and the desert resort areas around Palm Springs and Twentynine Palms have long suffered from traffic congestion in the Redlands area due to the traffic signal controls and restricted speed zones. The accident rates for sections of the now superseded highway have been higher than the statewide rates for similar types of highways.

These projects, which extend the freeway on U.S. 70-99, a distance of 10.8 miles from the intersection with U.S. 91-395 south of San Bernardino to 0.9 mile east of the city limit of Redlands, provide six lanes of pavement for this major transcontinental route, also designated as Interstate Route 10.

. . . Continued on page 9



This aerial, looking northwest from above the University Street undercrossing, shows the completed freeway through Redlands and the San Bernardino Valley in the distance. The old four-lane highway is to the left.



A map of the freeway through Redlands and the Loma Linda area. Location of the materials sites used during construction are also shown.



BEFORE—US 70-99 through Redlands before the freeway was completed. The photo shows westbound traffic held up by the traffic signal at Waterman Avenue.



AFTER—Traffic moves along the new freeway near the Palm Avenue undercrossing.

REDLANDS FREEWAY

Continued from page 7 . . .

Two Contracts

The two contracts, which were opened to traffic with impressive ribbon-cutting ceremonies on August 28, 1962, complete 68 miles of continuous full freeway on Interstate 10, from downtown Los Angeles to 2.6 miles east of Redlands. Easterly on this interstate route, for a distance of 58 miles to Indio, the highway is either full freeway or divided expressway which is rapidly being converted to full freeway standards. Construction to full freeway, for a distance of 6 miles east of Banning, is provided in

. . . *Continued on page 10*

EDITOR CITES ADVANTAGES OF ELEVATED FREEWAY IN REDLANDS

The following editorial, headlined "The Beautiful Freeway and Redlands Future" was published in the August 29, 1962, issue of the Redlands *Facts*. It is reprinted by permission of Frank E. Moore, editor:

To anyone riding on the new freeway through Redlands, the most characteristic reaction will be "my, what a beautiful town." The freeway shows off Redlands like no other route in the community. For the first time since Smiley Heights was closed to the public, the motorist views Redlands in its full glory.

The landscaping of the freeway is now being planned. Like any roadway there are a few eyesores along the way, but these will be screened by plantings envisioned by the City Park Commission and the State Division of Highways. In its final form a few years from now, this will be one of the most beautiful stretches of roadway in the West.

What this means for the future is not too difficult to imagine. Redlands from the freeway will be its own best advertisement. How many people will it beckon? Drive around Southern California and then make your own guess. It will be plenty, but let us hope they don't come in a deluge.

For the economy of Redlands, the long term advantages of the freeway will be important. The through traffic with its noise and hazards will be above town. The city will no longer be divided by masses of cars and trucks that have crowded Highway 99 much of the time. Now it will be possible to cross town conveniently and safely.

This will return the downtown district from City Hall to the Colton avenue hill, to Redlands. It will no longer be sliced by the Highway.

Some businesses which cater to highway traffic may feel an adjustment for a while, but the pattern elsewhere has shown that the long term result is favorable.



Old US 99 in Redlands following the opening of the freeway. Redlands business men are "sold" on the benefits of the freeway to their city and have put up signs such as this one telling everyone so.

The freeway will cause changes in traffic patterns in the community. The on and off ramps and the arterials leading to them will stimulate new driving habits for many a Redlander. This will mean new residential and business developments.

As Redlands faces the future, it is appropriate to note that this extraordinary roadway would not have been built on such an excellent route had it not been for the officials of the city of Redlands and for the city planning department which first had the courage to originate it.

To anyone who followed the developments of the freeway over a 10-year period, it is a marvel that it was possible to reach such a satisfactory outcome. Redlands of tomorrow will be grateful for the judgment exercised by public officials of city, county, the State Division of Highways and Highway Commission. A word, too, should be said for the civic leaders who played such an important role in helping to reach a solution to one of the knottiest problems that confronted Redlands in its 75-year history.

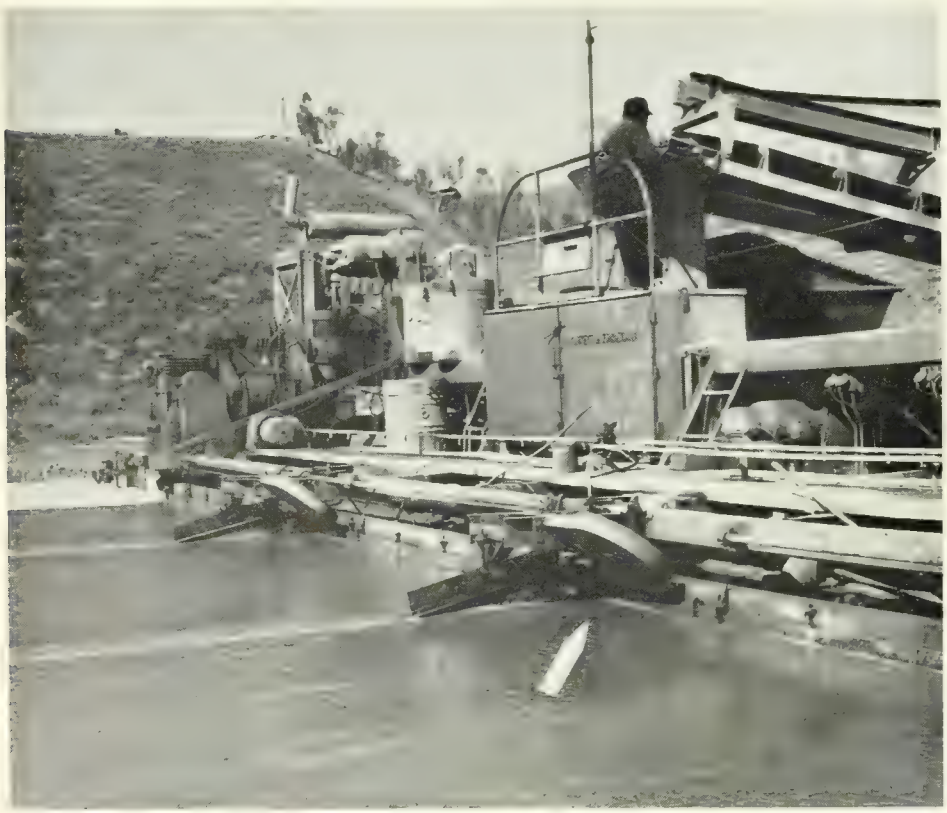
The freeway through Redlands cost $7,946,638 plus the cost of the right of way. The stretch from Redlands to the Octopus cost $6,839,180. Right of way for the two jobs ran to $7,100,000. This expenditure of $23-million is the largest public expenditure to be made in this area in history.

There will be additional costs of improving local connecting streets such as Tennessee street and Ford. This will come in time as the traffic creates the demand.

Taxes on highway users pay the bills. In return, the driving public has a roadway that will be universally proclaimed superb.



FREEWAY CONSTRUCTION—A slipform paver fed by two dual-drum mixers paves three lanes with one pass. Shown successively back of the paver are the pipe float, burlap drag and spray outfit for application of curing membrane.



FREEWAY CONSTRUCTION—This slipform paver carries vibrating plates and drums of plastic tape (white arrow) for longitudinal joints.

REDLANDS FREEWAY

Continued from page 9 . . .

the current state highway budget with construction expected to begin this winter.

The westerly of the two projects that were opened to traffic simultaneously on this freeway was the contract between U.S. 91-395 and Colton Avenue. Under contract to Matich Constructors and W. F. Maxwell Company for $7,500,000, it stretches 5.8 miles and has been under construction since February, 1961.

The new alignment runs north of and is approximately parallel to the existing highway. It passes north of the business district of Loma Linda. Eleven bridges are required on this unit to separate cross traffic.

The major contract items included 192,000 cubic yards of roadway excavation, 4,350,000 tons of imported borrow, 200,000 tons of imported subbase material, 127,000 tons of untreated base, 233,000 square yards of concrete pavement, 21,100 cubic yards of bridge concrete and 5,100,000 pounds bar reinforcing steel.

The materials for the embankments and construction of subbase were obtained from the nearby Santa Ana River. Arrangements for one source from which the Contractor obtained 600,000 tons of material were made by the State. From other sources arranged for by the Contractor, 3,950,000 tons of material were obtained. These material sites in the Santa Ana River were excavated to lines and grades established by the San Bernardino County Flood Control District with resulting excavations conforming to county plan for future channel development.

Total daily production during the period of heavy earthmoving operations averaged 29,500 tons per day. This was accomplished by using two separate spreads, one from the state-designated source and adjacent areas (scraper haul), and one from contractor-developed source between extensions of Mountain View Avenue and Nevada Street (truck haul).

The average production for the scraper operation was 12,000 tons per eight-hour day. Ten rubber-tired scrapers were used for hauling with

two large crawler tractors used in the excavation as push loaders.

The average production from the contractor-developed source was 17,500 tons per 10-hour day. The material was pushed to belt loaders with bulldozers. Bottom-dump trucks were used for hauling.

A substantial increase in the speed of the operation at this source was achieved by use of a truck scale with an in-motion weighing device. By means of an electronic attachment, it was possible for the trucks to proceed across the scale platform at reduced speed and, without stopping, register the weight of the load. The scale provided duplicate tape records of the weights, one for the State Division of Highways and one for the contractor.

Pavement Widths

The 36-foot width of concrete pavement on this contract was placed with a Lewis slip-form paver. The two outside lanes, 24 feet in width, were placed monolithically. The adjacent inside lane was later placed with the paver reduced to a 12-foot width. To obtain pavement grade, this machine depends upon the smoothness of the subgrade and the straight edge characteristics of its tracks. The screed is rigidly set for depth of pavement required. A six-inch-diameter pipe float was operated manually behind the paver to improve the smoothness of the finished pavement. Smoothness specifications for the completed pavement permitted 0.01 foot deviation from a 12-foot straightedge longitudinally and 0.02 foot transversely. High spots were ground off with a concrete bump cutter. The riding qualities of the pavement are very good, with an average reading of 2.0 inches per mile, as determined by the California profilograph. Daily production of concrete was 1,200 cubic yards for the 24-foot width of pavement and 1,000 cubic yards for the 12-foot width.

Job superintendent for the contractor on this contract was Ed Morris. The State was represented by Paul Kirst, resident engineer, and Don Alden, Bridge Department.

The easterly unit of this freeway extends through Redlands on new alignment from Colton Avenue to 0.9 mile beyond the east city limit, a distance of approximately five miles. Construction of this unit, under $8,500,000 contract to Fredericksen & Kasler and Gordon H. Ball and Gordon H. Ball, Inc., was begun in April 1961.



LANDSCAPING—Planting palm trees at the University Street overcrossing along the new freeway.

Fifteen major structures are required on this project to separate cross traffic and provide adequate interchange facilities. At one of these structures, the Colton–New York Undercrossing, record concrete pours were made.

The structure provides two separated roadways 66 and 68 feet in width. It is a four-span, reinforced-concrete, box-girder bridge about 380 feet long supported on reinforced-concrete column bents and abutments. The box-girder section is 6.5 feet deep. On January 23, 1962, the soffit and stem pour was made for the right bridge. The contractor placed 1,527 cubic yards of concrete between 3.30 a.m. and 7.30 p.m., a total of 16 hours. During the early hours of darkness, concrete was end-dumped from the trucks at the abutments and was wheeled over ramps from the hopper in 15 buggies. The hand-operated buggies placed about 350 cubic yards during the day in an area directly beneath low overhanging high-tension wires. Beginning at about 6 a.m., five truck cranes, each with two concrete buckets, began work. During the final hour and a half, the remaining concrete was placed with a single truck crane.

The pour was made difficult by the overhead wires and traffic on Colton Avenue. For 80 percent of the time, the cranes had to be spotted at the street level below with placing done by signaling from the deck level.



Looking north over the Wabash Avenue Interchange. The new freeway in this section (left to right) follows the general alignment of Reservoir Canyon.

Concrete was batched from two batch plants located a few miles away on Alabama Street.

On March 27, 1962, the soffit and stem pour was made for the left bridge. The contractor placed 1,598 cubic yards of concrete between 5.00 a.m. and 5.30 p.m., a total of 12½ hours. The pour proceeded the same as above, except that only four truck cranes were used. About 400 cubic yards were placed with the buggies. A factor which contributed to the decrease in placing time over that in the other pour was the spotting of two of the cranes on the deck slab of the right bridge.

There are approximately 750 cubic yards in each of the two top deck slabs. Because of the large area and excessive widths, a longitudinal construction joint was placed in each deck providing for four pours of about 375 cubic yards each.

Pours Believed Largest

Each of the above soffit pours of 1,527 cubic yards and 1,598 cubic yards is believed to be the largest single concrete pour ever made on a state bridge structure of the box-girder type. It is also believed that the previous largest pour (also made by Fredericksen & Kasler) was 1,460 cubic yards.

Other major items of work on this project include 1,300,000 cubic yards of roadway excavation, 59,700,000 station yards overhaul, 2,152,000 tons imported borrow, 106,000 tons imported subbase material, 95,500 tons untreated base, 288,000 square yards concrete pavement, 34,800 cubic yards bridge concrete and 8,100,000 pounds reinforcing steel.

In addition to the roadway excavation amounting to 1,300,000 cubic yards, it was necessary to import 2,258,000 tons of material to complete construction of the embankments and provide material for subbase, 1,511,000 tons were obtained from optional sources arranged for by the State and 747,000 tons were obtained from sources developed by the contractor.

During full-scale grading operations on the Fredericksen & Kasler contract, the production of roadway excavation was 15,200 cubic yards per day and the production of imported borrow averaged 11,900 tons per day. The roadway excavation was moved with 12 rubber tired scrapers. Two large crawler tractors were used to assist in loading. The imported borrow was hauled with 20 bottom-dump truck and trailers. Three dozers and a modified loader were used for loading the vehicles.

One Operation

On this contract, the 36-foot width of concrete pavement was placed in one operation with a Guntert & Zimmerman slip-form paver. During this one-pass operation, the longitudinal joints at the lane lines were also formed by insertion of a polyethylene plastic strip two inches in depth in the fresh concrete.

An important distinguishing characteristic of this paver is the electronic guidance system which maintains the machine on predetermined alignment and grade for the completed pavement. Guidance is accomplished by use of sensing elements which operate along tensioned piano wires preset at constant lateral and vertical offset from the pavement edge.

As on the adjoining project, a six-inch pipe float was manually operated behind the paver to improve the smoothness of the finished pavement. The same specified tolerances for smoothness also were in effect.

The production with two mixers averaged 2,250 cubic yards of concrete per day. The riding qualities of the pavement are excellent with an average profilograph reading of 1.5 inch per mile. The overall range for daily runs was from 0.3 to 4.0.

Freeways & Cities

State Engineers Right, Say Banning, Beaumont

(Editor's note: The following article, originally in two installments, appeared in the July 15 and July 22, 1962, issues of the Riverside *Press-Enterprise*. It was written by George Ringwald of the *Press-Enterprise* staff.)



It's taken a while, but the San Gorgonio Pass Communities of Banning and Beaumont have learned what the State Division of Highways engineers has said all along: Freeways that by-pass a community don't hurt the town's business—they help it.

The lesson hasn't been brought completely home yet in Beaumont, because the first shock hasn't quite worn off; it is not quite a year since the state opened the new freeway routing of Highway 60-70-99 south of the town's business district, and it takes at least a year usually for business to start bouncing back.

Beaumont's neighbor to the east, Banning, appears to have completely recovered.

But then it has been six years now since the freeway route was opened just south of Banning's main business district.

"The first few weeks after it opened," recalled one oldtimer, "it seemed real dead—and very strange to be able to find a parking place on Ramsey Street (which carried the state highway traffic previously. But now the traffic is almost as heavy as before."

Banning's city manager, W. F. Peterson, said: "It's been our experience that the town seems to have continued to grow ever since that thing was put in. There've been very few businesses that have folded up, outside of a couple of cafes that were operating on a shoestring anyway. Shortly after the freeway went in here, we lost one service station, and that was because his lease ran out."

Statistics Prove

Statistics bear him out.

The number of water meters, for instance, has climbed from 3,041 in 1958 to 3,288 in 1959, to 3,562 in 1960, to 3,720 in 1961. The number of commercial electric meters has shown a similar steady climb—from 479 in 1958, to 488 in 1959, to 515 in 1960, to 519 in 1961.

In July of 1956, which was when the once-feared freeway opened in Banning, the city's population was 8,628; today it is estimated at 11,300. In 1956, Banning's assessed valuation was under $10 million; today it stands at more than $13 million. Postal receipts have gone up from $117,145 in 1958 to $176,541 in 1961.

This hardly looks like a town that is dying on the vine, as motorists catching a passing glimpse of it from the freeway might suspect.

W. B. Eaton, manager of Banning's Security First National Bank branch, noted that the bank has had a 16 per cent increase in deposits from 1957 to 1961, and a 14 per cent increase in the number of loans.

"And that," added Eaton, who is also vice president of Banning's Chamber of Commerce, "is about the growth of the community, I would say."

One of the town's leading real estate men, Jimmy Thompson said: "For the first six months, everybody said the town was going to die. Now, there's as much traffic as ever, and they're talking about needing a traffic signal on Eighth Street now."

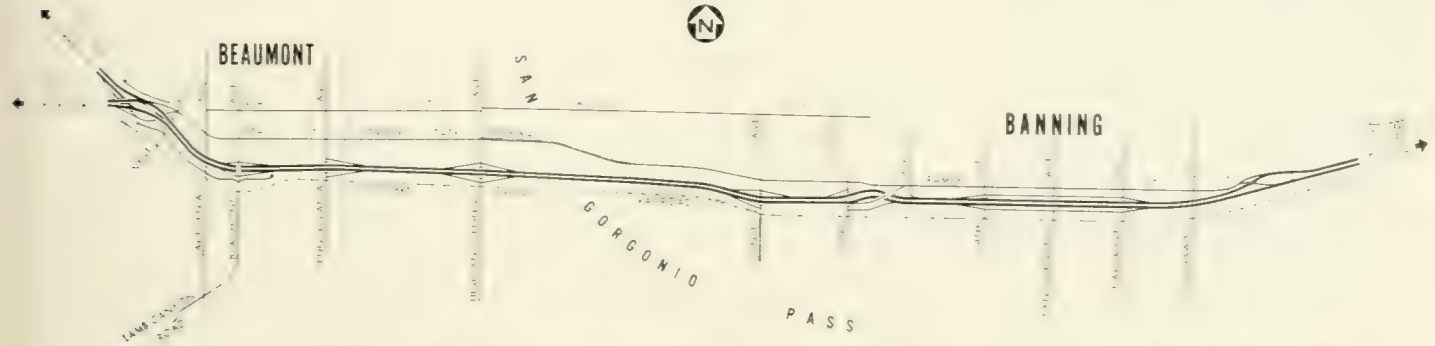
Land Prices Up

Thompson and associate Chester Hendricks, both old-timers in the community, say you can't buy any acreage for less than $2,500 an acre today, and it goes up as high as $7,000, in an industrial zone.

"Seven years ago," said Hendricks, "there was one fellow who sold all of his orchard land for $650 an acre; now, it's priced at $3,500 an acre."

At $2,500 and $3,500 an acre, it is simply not economically feasible to use the land for growing cherries or peaches and apricots, and it is indicative of Banning's growth—which has never been of the spectacular boom type, although it has grown in stature in recent year as an industrial site—that almost all of its 4,000 acres of orchard are now gone—into residential subdivisions, into commercial businesses, into industry.

Even in the hinterland along the highway between Banning and Beaumont, a stretch of several miles of



The San Gorgonio Pass Freeway through the cities of Beaumont and Banning carries all US 60-70-99 (Interstate Route 10) traffic through the area.



The San Gorgonio Pass Freeway, looking eastward. Beaumont is in the left fore and middleground, Banning in the distance. The freeway has taken the through traffic load off the city streets.

mostly undeveloped land, property owners are today asking $2,500 an acre for land that sold for $500 an acre four years ago.

(It is in this sort of no-man's land, incidentally, that the few scattered businesses—a restaurant here and there, a fruit stand, a service station, a motel —were hardest hit by the freeway, since they relied so heavily on highway traffic.

In downtown Banning, business property that was priced at $300 and $400 a front foot before the freeway is now listed at $500 and $600. In the rapidly developing west end of Ramsey Street, business property is listed at $350 a front foot today, and just a few years ago you could have bought it for $50.

Recovery Underway

If Beaumont is not quite recovered from that first shock of the freeway operation, most of the town's businessmen will tell you that it's well on its way. And a drive around town certainly doesn't show any evidence of a business community on the skids; one is, in fact, impressed by the number of attractive new business buildings — a new shopping center, a new savings and loan office, new appliance stores, new service stations.

A market on downtown Sixth Street —the route of the highway traffic before the freeway—is closed, but it was the general trend of development toward the north and east that forced it out, not the freeway.

The city clerk, Bernice Conine, notes that the cancellation of business licenses since the freeway has been neg-

ligible. The city's sales tax receipts did decline since the freeway—from $47,-532 in fiscal 1961 to $46,968 in fiscal 1962—but it was a slight drop, and it could undoubtedly be laid to the falling off at the motels, restaurants and service stations, which are expected to gradually recover.

C. B. Linquist, manager of the First Western Bank in Beaumont, said, "I've seen this happen in other areas where I've been. Like all areas by-passed by freeways, there's a period of adjustment. It hasn't recovered completely, but it will in time."

Actual Help

It is not just that the new freeway routing of 60-70-99 past the twin communities of the San Gorgonio Pass, Banning and Beaumont, has not hurt them—it is that most of the civic leaders and businessmen of the communities feel it has actually helped them.

As Beaumont's Mayor Aubrey Allen expressed it:. "All in all, I think it's a good thing. The town will probably now grow along different lines—it's much more satisfactory for our people to be able to come downtown and shop now."

Banning's City Manager, W. F. Peterson said, "I remember back when we had all that traffic, the people who were in that line of cars were anxious to stay in line and get through town as fast as they could. Now, they can get off and park a while and use some of our facilities."

There had been some apprehension in Banning that the freeway would split the town in two. (Although most businessmen wanted the freeway built as close as possible to the old business-highway route along Ramsey Street—rather than farther south along the base of the San Jacinto Mountains, where the state highway engineers originally planned it.) But this hasn't happened.

"In fact," said Peterson, "I consider the railroad more of a detriment to the town than the freeway."

When trains are stopped along the Southern Pacific's tracks through town, Peterson explained, there is not only a tieup of industrial employes wanting to get back to work after lunch, say, but there is the more serious possibility of preventing police or fire protection from reaching the other side of town. An underpass is needed "very badly," Peterson feels.

One Complaint

If there is one complaint that Banning and Beaumont both have, it is that there are not enough off-ramps or that there is not sufficient notice of them to the motorists approaching the towns.

Said Peterson: "People who want to go to Idyllwild or the airport or any of the manufacturing plants—if they miss the Eighth Street off-ramp, they have to go half way to Cabazon before they can get back."

The freeway has done for both Banning and Beaumont what the two communities might have been a long time in doing for themselves—if ever.

In both towns, the route picked (for obvious reasons of economy) was through their worst sections, and it eliminated many of their substandard buildings, both residential and commercial.

As H. E. Flannery, Beaumont's director of planning and building, commented: "It certainly has taken out a lot of old buildings that normally would have taken us a long time to get removed. It has helped to beautify and clean up the town."

The freeway has certainly had no adverse effect on the value of adjacent property—as some feared it might.

One Beaumont real estate dealer, Emil Wohlgemuth, noted, for instance, that a 10-acre parcel lying between the freeway and Beaumont's Sixth Street (the old highway route through town) sold for $40,000 some years back, and is now being held for $200,000.

"I thought it was ridiculous," said Wohlgemuth, "but sooner or later I believe someone will buy it for that."

The general feeling in the two Pass communities was that restaurants, service stations and motels—the businesses relying most directly on tourist traffic—would be the hardest hit by the new freeway routing, and the exception was generally realized, although even in these businesses there are some who feel the freeway helped rather than hurt.

Motel Business Up

Patrick Dundas, a Banning motel owner and president of the town's motel Association, said: "The peculiar thing of it is that the freeway had a good effect. Our business got better after the freeway opened. The first day it opened, it didn't look like there was any traffic at all, but that night we were full. There were people who had come this way and they got so they hated Banning because of the traffic jam."

Beaumont's Mayor Allen said: "Some of the motel operators tell us it hasn't hurt them at all. Salesmen stop off now that didn't before—they like it better because it is quiet."

And ladies attending meetings of the Beaumont Woman's Club on Sixth Street will tell you they're delighted with the change—"you never could hear anything before, for all the truck traffic going by," said one.

There have been a number of restaurants close up on the old highway strip between Banning and Beaumont, but those who didn't panic and could hold on to survive that initial shock that follows for six months to a year after any freeway rerouting will tell you that the business is slowly starting to find them again.

(Some highway businesses, however, are not likely to ever return. The little countryside fruit stands and hot dog stops may be gone forever from the new land of freeways—"a casualty to progress," one Banning businessman called them.)

It is the same story everywhere you go.

"I have a feeling in one sense it's helped," said Beaumont hardware store operator Myrl Beck. "People who didn't like to cross town before with all the traffic, now can come in with ease.

"I really think that in the long run it is going to help us," Beck added.

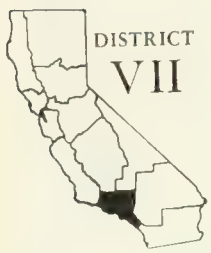
"When I first came here 32 years ago," he said, "the highway came up Fifth Street. It's moved three times since I've been here and twice before. There've been five different highways through Beaumont and four different business sections, and none of them amounted to anything because we were always waiting for the next move.

"Now," he said, "we can build a business community and forget the highway."

Traffic Relief

Loop Freeways Ease Congestion In Metropolitan Los Angeles

By HEINZ HECKEROTH, Executive Assistant



The recent completion, and opening to traffic, of new freeway segments in District VII has provided many travel alternates on the network in the downtown area. A new high level of service is now afforded metropolitan freeway users; with less probability of interruption of smooth traffic flow due to congestion, and more desirable speeds of operation with resultant travel time savings.

Very significant relief is noted on the Santa Ana Freeway in the civic center "slot area" between the four-level structure and the San Bernardino–Santa Ana Freeway junction. With the option of alternate routes, the slot volume has decreased from an average of 185,000 vehicles per day to 160,000 per day—13 percent less total volume. Peak-hour relief averages 7 percent, creating smoother flow through the area.

The Golden State Freeway, now open from the East Los Angeles Interchange to Lankershim Boulevard in the valley, has virtually eliminated congestion on San Fernando Road and Riverside Drive due to very large diversions to the freeway from these thoroughfares. As a bypass of the downtown area, a very steady growth is noted. When open only from the Pasadena Freeway to Lankershim, the daily volume was 54,000 vehicles per day, but the current volume is 111,000 daily just west of the Pasadena Freeway Interchange. As a truck route, the growth is phenomenal, an increase of 40 percent over earlier truck volumes while Hollywood Freeway trucking has decreased by 16 percent.

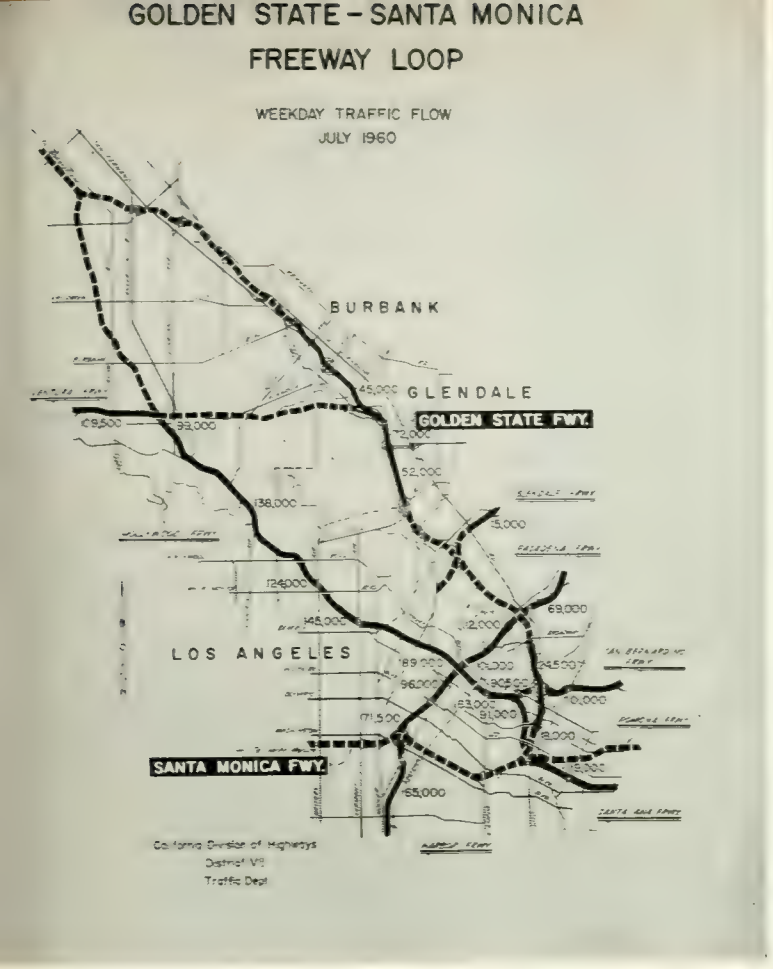
Total volume on the Hollywood Freeway has not decreased, but traffic flow is smoother due to the alternate routing now available; offpeak relief is very noticeable, and because of lesser demand through the "slot,"



BEFORE—Traffic congestion on the Hollywood Freeway in the Cahuenga Pass before it was widened.

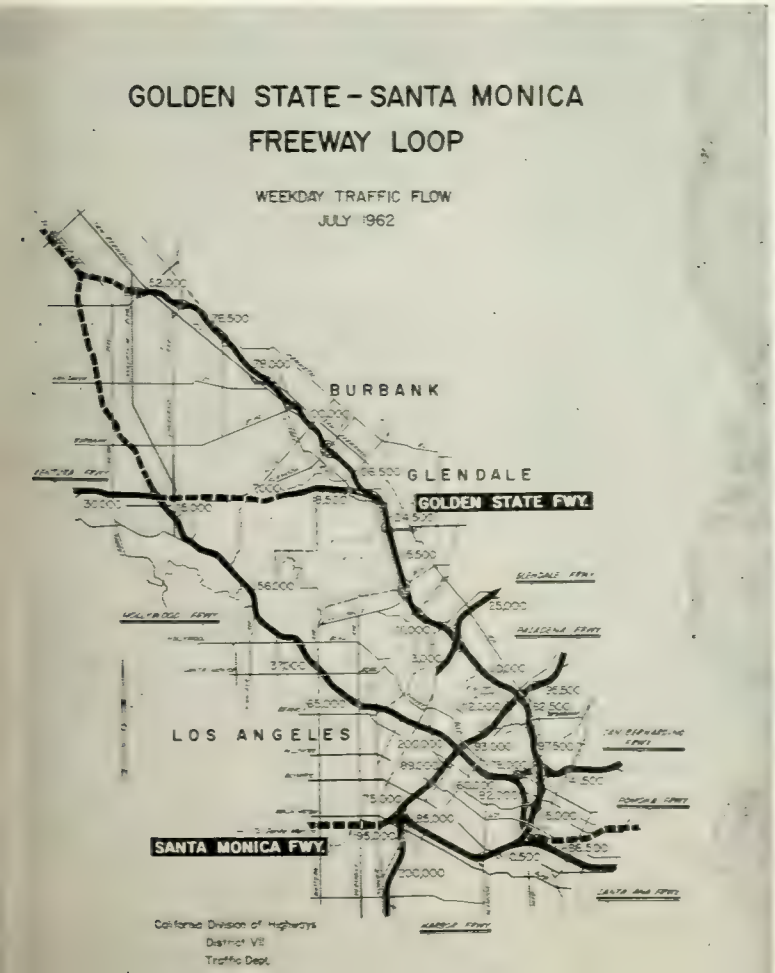


AFTER—The Hollywood Freeway in the Cahuenga Pass after it was widened to five lanes of traffic each way. Note the median barrier fence dividing the roadways.





MAPS ABOVE AND BELOW LEFT show the change in weekday traffic counts during 1960, 1961 and 1962 at specific locations as portions of the Loop Freeway system were completed and opened to traffic. PHOTO BELOW RIGHT—The East Los Angeles Interchange where the Santa Ana, Santa Monica and Golden State Freeways converge.







The Santa Monica-Harbor Freeway Interchange, a part of the Loop. The view is eastward. The section of the Santa Monica Freeway in the final stages of construction when this photo was taken (foreground) is now open to traffic as far as Vermont Avenue.



Looking north along the Golden State Freeway section of the Loop. In the foreground is the Elysian Viaduct and Pasadena Freeway Interchange.

peak-hour flow is likewise smoother and less congested.

The Santa Monica Freeway, closing the "loop" between the East Los Angeles Interchange and the Harbor Freeway, has made a tremendous contribution. Volumes have steadily grown since the opening of the last link at the end of March, the current daily average being 97,000.

The opening dates of the various sections of the loop freeway system are as follows:

GOLDEN STATE FREEWAY

Los Angeles River to Alameda Street, length 2.2 miles, opened to traffic in September 1957.

Glendale Boulevard to the Los Angeles River, length 2.5 miles, opened to traffic in December 1957.

Alameda Street to Burbank Boulevard, length 1.3 miles, opened to traffic in May 1959.

Sixth Street to Pasadena Avenue (includes the San Bernardino Freeway Interchange), length 2.4 miles, opened to traffic in March 1960.

The Santa Ana Freeway to Sixth Street, length 1 mile, opened to traffic in May 1961.

Burbank Avenue to Lankershim Boulevard, length 5.3 miles, opened to traffic in July 1961.

Arnold Street to Glendale Boulevard (includes the Glendale Freeway Interchange), length 3.0 miles, opened to traffic in January 1962.

Pasadena Avenue to Arnold Street (includes the Pasadena Freeway Interchange), length 1.0 mile, opened to traffic March 1962.

SANTA MONICA FREEWAY

Hooper Avenue to the Santa Ana–Golden State Freeways (includes the East Los Angeles Interchange), length 1.8 miles, opened to traffic in December 1961.

Main Street to Hooper Avenue, length 1.2 miles, opened to traffic in January 1962.

Oak Street to Main Street (includes the Harbor Freeway Interchange), length 0.8 mile, opened to traffic in March 1962.

Hoover Street to Oak Street, length 0.5 mile, opened to traffic in June 1962.

Kidproof Railings

Safety Offers Challenge On Pedestrian Crossings

By A. L. ELLIOTT, Bridge Engineer, Planning

When Tom Sawyer walked along the top rail of a picket fence, his only concern was to be careful lest he tear his pants—for that would certainly have resulted in Aunt Polly tanning his hide. He didn't anticipate the modern day concept that if he tore his pants or impaled himself on one of the pickets, he could then sue the property owner.

Had there been a freeway nearby and had Tom hurt himself because he walked on top of, on the outside of, or crawled through the railing of one of its pedestrian overcrossing structures, Aunt Polly could have brought the matter up as a community issue, asking the state to provide a safe railing for the protection of their children.

What is a safe railing on a pedestrian overcrossing? The meaning of the term seems to have changed over the years. A few years back, a safe railing was one which was high enough and strong enough so that if a person walking beside it stumbled or fell against it, it was high enough and strong enough to prevent his falling through or over. Now, a safe railing has become one which cannot be climbed, cannot be crawled through or on the outside of, one which has mesh small enough so that things cannot be thrown through or over onto the traffic below, yet it still must be open to provide visibility and ventilation. The only feasible solution thus far has been complete enclosure of the pedestrian area with wire mesh, with provision made at the ends so there can be no access to the outside of the cage. A "cage" is just what it is, and it spoils the looks of the structure as well as many of the pleasures of walking across it.

Transition Not Sudden

This transition from an open railing to a cage has not come suddenly. Most of the change has come in the past 10 years. During these recent years there has been a drastic change in the definition of what "safe" means. Actually this is only part of a great social change



A concrete railing of a decade ago. The rail was three feet high and the windows were 10 inches wide.



Here the concrete railing has been faced with a chain link fence so children cannot climb out through the windows and an additional fence has been placed on the edge of the sidewalk to keep them from jumping out into the street.



This was the improved steel rail with the round top to prevent walking and closer ballusters to prevent crawling through. This was 1954 and the joys of throwing things on the cars on the freeway below had not been discovered.

of much longer duration. Relief is sought under the laws of negligence more than ever before. Substantial damage verdicts are now awarded on grounds never dreamed of in Tom Sawyer's day. With this change in social attitude toward liability and damages has come a changed concept of the responsibilities of the State toward preventing accidents.

Some years ago the customary railing on a state highway bridge was a concrete rail three feet high with round-topped windows 10 inches wide between 6-inch concrete posts. This was a strong and adequate railing. A 10-inch window was wide enough for a small child to crawl through but if one tried to, someone presumably boxed his ears and told him to get back on the sidewalk where he belonged. The railing was a foot wide on top, and probably a few boys walked on it—if they didn't get caught by their mothers.

The first modification came as an improvement of appearance and also improved safety. Because there was a chance of a small child falling through the 10-inch windows and increased concern about such possibilities, and because a somewhat lighter weight railing looked better and gave greater visibility in urban locations, a steel railing was developed. It was three feet high. It had one-inch-square ballusters with six-inch open spaces, and it was flat on top.



As the idea spread of throwing things on cars passing underneath, chain link fences were added. This was little deterrent, however, as they could lob things over the top with good accuracy. The next step was completely enclosing the walkway.

Causes Criticism

Criticism was not long in coming. Pictures were published of small children squeezing through between the ballusters or walking on top. The railing became a challenge. There was no shortage of able Tom Sawyers, but we seemed to have completely forgotten Aunt Polly's approach to the problem. A meeting was called in one city to protest the railings which the State proposed to put on the structures carrying streets across the new freeway. The chief of police succinctly suggested that a proper application of a willow switch here and there would soon cure the problem of children climbing on the railing. His suggestions fell on deaf ears. Aunt Polly had not attended the meeting.

We wondered how the three-foot height and the six-inch openings of our railing compared with those used in the rest of the country. We asked each state how it made its railings and how wide the openings between balusters. We found that 65 percent of the states used railings three feet or less in height. Also 73 percent of them used balluster openings of six inches or more. In other words, California was more cautious than most of the states. Nevertheless we raised our sidewalk railings to 3½ feet to get an extra margin of safety.

An enterprising bridge engineer whose wife worked in a day nursery devised a test slot through which the children were encouraged to try to climb. Nineteen four-and five-year-olds did their best. The controlling factor turned out to be the size of their heads. All of them went through a 6½-inch opening. Four were stopped by a 6-inch opening. Six were stopped by a 5½-inch opening and the remaining nine could not get through a 5-inch opening. On the basis of this very scientific information, the balluster spacing was reduced to five inches clear. This reduction in balluster spacing reduces the "see-through-ability" and is specially objectionable from the side where the railing is viewed at an angle as from a side road approaching an intersection near the end of the bridge. The close-spaced ballusters form a solid screen and shut off the vision of vehicles crossing the structure or approaching from the side.

The walkable flat top of the rail was then criticized. Existing railings were modified. Vertical and sloping plates were welded on top. Short spikes were set along the top of the rail. These were all to a degree successful but were uniformly unsightly. The design of the railing was changed again. Manufacturers who had invested in costly jigs to make the railing began to develop a frustrated look. The railing was made narrower and was rounded on top. Then some kids began riding it like a horse and inching their way out across the span while they straddled the railing. One boy doing this fell off. He was not seriously hurt but his wails echoed up and down the State.



This was the answer to the suicide reputation of the old Arroyo Seco arch. The new structure has this vicious-looking but effective railing.

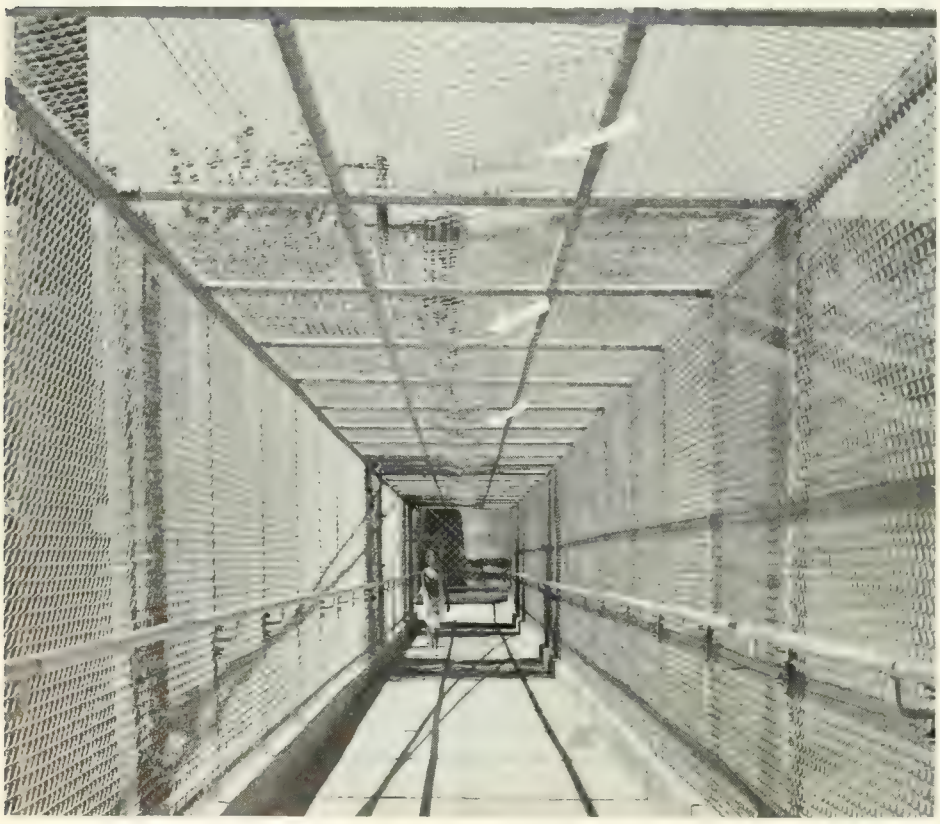
New Railing Developed

Some communities took matters into their own hands and bolted chain-link fences to the railings. Some fences were installed by the State at city request. A new railing was developed with one-inch-square solid bars with five-inch openings extending 5½ feet into the air. This was an adaption from the special railing devised for the Colorado Street arch in Pasadena to prevent suicides. This rail, with its eight-foot height and the sharpened points turned in toward the roadway, had proved almost 100 percent effective. There was one exception. The victim stood on top of his car and dove over the railing.

About this time another factor entered the railing picture. With the advent of freeways, thrill-seeking youngsters found pleasure in dropping things on the cars passing underneath. They found windshields could be broken and considerable excitement caused with a minimum expenditure of effort. A new cry arose. This had to be prevented. Torso tanning is no longer an acceptable solution. The construction had to be such as to make it impossible for things to be dropped on cars below. High mesh fences were erected. These were found to be ineffective. The kids lobbed rocks and pop bottles over the top with devas-



Completely enclosed, even on the ramps, this pedestrian structure near Sacramento looks very well protected. This apparently is regarded merely as a challenge by the children. The entire length of the roof of the cage across the freeway and down the ramps, is beaten down where countless children have crossed and bounced on the top of the cage instead of staying inside where they should be. (See photo below.)



A close-up of the pedestrian overcrossing shown in the above photo. Note how the roof of the enclosure has been beaten down by children climbing on top and bouncing on it as on a trampoline. The next step is to round the top.

tating accuracy. The entire walkway had to be enclosed.

Metal Shell Is Installed

A railroad passing under the Baltimore–Washington Parkway found itself obliged to install a sheet-steel shell over the sidewalk on the overcrossing to prevent kids dropping things onto the trains as they passed underneath. Here in California we enclosed the entire walkway on pedestrian crossings near schools. An eight-foot fence on each side and mesh across the top. This was another challenge. The kids climbed outside and on top and used the flat mesh on top as a trampoline. Now we build the top rounded.

It became quite a feat to work one's way across along the outside of the cage. To prevent this, various devices were tried. Wing fences flaring out from the ends of the cage are effective if they extend far enough out into thin air. A city, thinking to economize, placed such a fence out in the middle of the structure. The kids were supposed to reason that if they could not get clear across, they should not start. One boy got out to the middle and tried to get around the projecting fence. He fell and was killed.

Preventive fences are installed at each end to try to keep the kids from getting outside at all. Barbed wire was used for a few installations but while barbed wire may be used as protection against animals and criminals, it is not cricket to use it against children. Now the end fences are just bigger and longer.

Litterbugs Also Offend

Children are not the only offenders. In spite of antilitterbug laws and propaganda, all manner of junk is flung from moving cars. If that car is crossing a bridge or viaduct, there can be serious danger to those passing or working underneath. Railroads and manufacturing plants under our viaducts are holding in abeyance suggestions for horizontal screens to protect them from objects thrown from cars crossing the viaducts until we can see how serious this problem is. This may well be the next defacement which we will have to attach to our structures as a symbol of the juvenility and



This railing was much better looking than the chain link fence but was too attractive to climb on, both inside and outside, and provided little interference to the rock and bottle droppers.

irresponsibility of a small segment of our citizens.

What does all this protective fencing do to the looks of the structures? It generally makes them look terrible. Ironically, it is the State that is usually criticized for designing "boxy, utilitarian" structures.

Designer's Dilemma

We are caught in a dilemma. We must build accident prevention into our structures and at the same time try to make them good looking. A bridge covered with chain-link fencing is not attractive. Other things have been considered. Clear glass would be broken. Clear plastic would be carved full of names and initials. Opaque glass or plastic panels have been seriously considered but they would shield the occupants from public view—a situation which entails other problems. In addition, any kind of a solid panel cover for the structures would cut off ventilation and make the interior intolerably hot under a summer sun. To date we have not been able to come up with any satisfactory solution better than the mesh fencing. It is regrettable that we must thus clutter our structures. However, lacking the training and responsibility which would make these junior citizens, and some senior citizens, aware of their obligations to others and to public property, we must act as though we were caging little wild animals.

The problems of providing an adequate and good-looking railing become evident. The variety of different protective railings throughout the State gives tangible evidence of the continuous effort we have been making. This business of coping with the mischievous inventiveness of a growing child is frustrating to say the least. To date we do not have the feeling that we are always winning. We need Aunt Polly and her strap. Her punishment was severe and immediate. Possibly it was harsh but also it probably developed character and respect for property. In the long run Aunt Polly's way was best.

Slip-form Job—Fresno

Variation of Previous Techniques Described

By N. E. HUMISTON, Resident Engineer

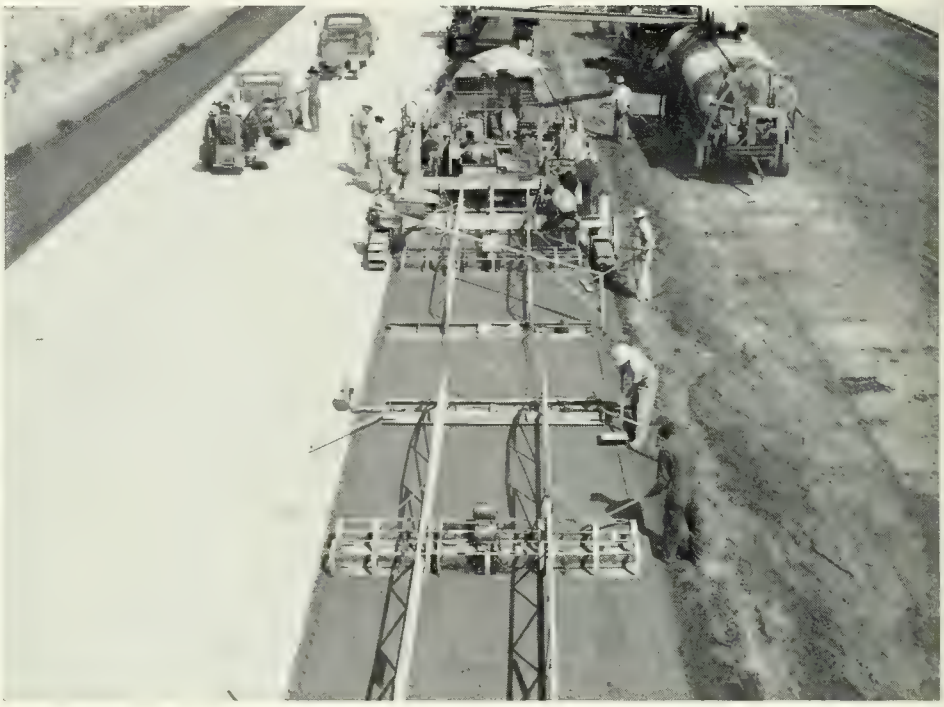


The brilliant teamwork of contractors, equipment manufacturers and highway engineers that has scored so many notable successes in creating the modern marvel of highway transportation constantly continues the dramatic advancement of construction technology that has characterized the development and expansion of the state highway system in California almost from the beginning.

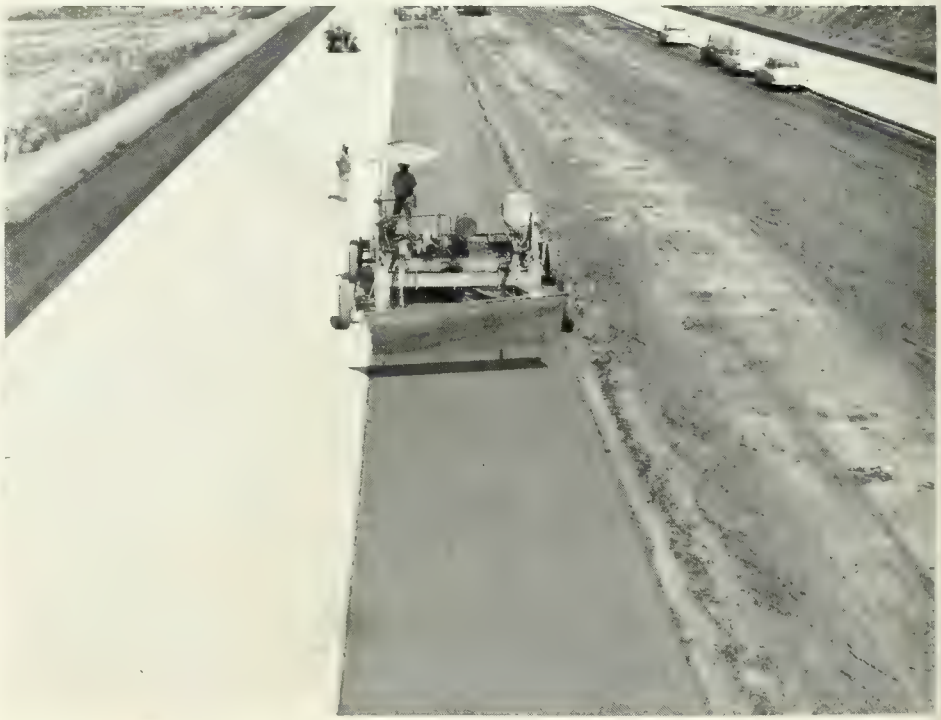
One important illustration is the slip-form method of constructing portland cement concrete pavements which is today contributing in significant measure to the accelerated program of highway construction to provide California and the nation with thousands of miles of safe, efficient highways and freeways at minimum cost.

As some of us recall so vividly, slip-form paving was introduced in California less than five years ago with great expectations and much enthusiasm. In the intervening months and years, the early enthusiasm waned and flickered in the face of seemingly insurmountable operational difficulties. However, despite all setbacks and with painful regard for the expense, the highway team doggedly refined the method and improved the equipment until today with over 450 lane-miles of mainline highway constructed to exacting specifications the slip-form process is emerging as the primary method of concrete paving.

Further improvements and refinements will continue to be achieved as experience grows. This article, one of a continuing series on the subject, reports the innovations and techniques employed on a current project involving 95,000 cubic yards of concrete pavement placed with nonautomatic slip-form paving equipment.



The paving train reduced to half width for the third lane.



The pipe float finishing machine reduced in width for a 12-foot slab.

The contract is one of three for converting U.S. 99 to full freeway standards from the Kings River in Tulare County to the completed section through Fresno, a distance of over 20 miles. An overall story of the entire relocation is planned for a later issue.

Construction Methods

In electing to exercise the contract option permitting slip-form paving the contractor recognized that very close grade and cross-section tolerances for the subgrade under the pavement would be vitally important in meeting the tight specification requirements for pavement smoothness. Consequently, it was decided early in the contract to exploit the long wheelbase land plane principle, utilized in the construction of the slip-form paver, in subgrading both the aggregate base and the overlaying cement-treated base. Thus the general plan adopted was to finish both base courses and then the pavement utilizing equipment with the same driving gear and long wheelbase planing action.

The two machines involved, a subgrader and a paving machine, are essentially mechanical straightedges 30 feet in length and capable of working to either 12- or 24-foot widths. Sufficient spreading and compacting gear is attached to insure that the mat of material being placed meets the required tolerances for thickness, grade, and riding quality. Both machines were built by the same manufacturer.

Aggregate Subbase

The contractor first constructed a subgrade at the top of the aggregate subbase. The subbase material was delivered to the grade by trucks and scrapers, roughly shaped with motor graders, and compacted. Grade stakes were placed two feet outside the planned edge of pavement and an electronically controlled motor grader was used to trim a track grade approximately six feet in width over these stakes. This track grade was used as a runway for the subgrader which then trimmed the surface of the subbase material to planned grade.



An aerial view of a section of the South Fresno Freeway under construction.

Aggregate Base

Subsequently, two windrows of aggregate base were placed on the prepared subgrade, the amount of material being carefully controlled by three different methods. First, automatic control devices were installed on the gates of each bottom dump trailer. These devices operated by means of a wheel rolling on the surface of the subgrade actuating the trailer gate through a series of lever arms and limit switches. The trailer gates opened or closed according to need so that regardless of the relation of the trailer to the subgrade a uniform volume of material was distributed. These devices worked well so long as the windrows were small enough for the truck and trailer to straddle completely the spread of the preceding truck.

Secondly, the volume of the windrows was checked by comparing delivered tonnage against the distance spread; and thirdly, the windrows were sized with a shaping device mounted on a motor grader.

After the windrows were placed, the subgrader was used to spread and trim the base material to the proper cross section ready for compaction. The subgrader consists of a steel framework about 30 feet in length and 24 feet wide, supported and self-propelled through four crawler treads mounted at each corner. Provision is made to reduce the width of this machine to twelve feet.

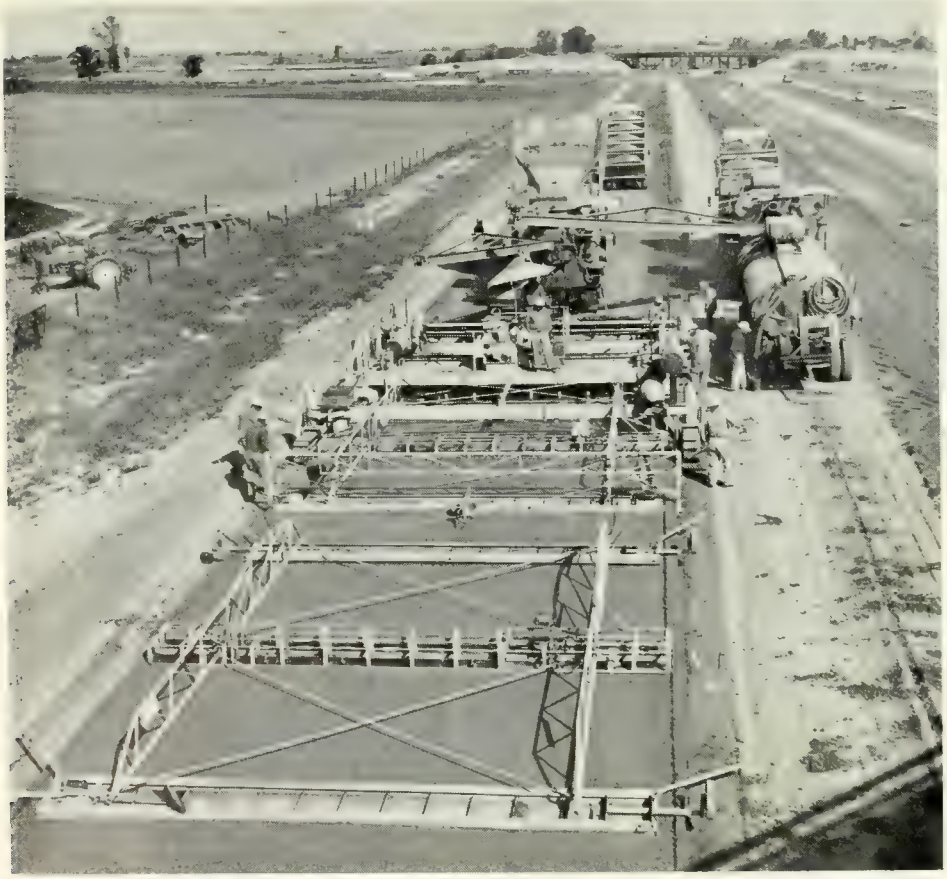
Suspended from the frame is a movable shoveling device used to spread material uniformly across the width of the machine. Two heavy, adjustable screeds oscillate over a distance of about 12 inches and strike the material off at the desired thickness. The forward crawler treads run on the surface of the previously trimmed base material and the rear treads ride on the surface of the material being placed. The height of the screeds relative to the elevation of the crawlers can be adjusted as needed. After compaction, the surface of the base was again trimmed with an electronically controlled motor grader and checked for cross slope and grade.

Cement-treated Base

The third operation was basically a repetition of that described above with the exception that the windrows of



A team of concrete mixers deposits fresh concrete in a spreader box ahead of a slip-form paver.



The slip-form paver towing transverse bump cutters. A polyethylene plastic strip is placed for a centerline joint.

base material were cement-treated prior to being placed and compacted. This material was placed two feet wider on each side than the planned width of pavement, which provided a track grade for the slip-form paver. These track grades were further checked for uniformity by string lining, and any appreciable roughness was removed by trimming or by filling with sheet asphalt as needed. A number of profilographs were run on these track grades for the paver and an index of well below 10 inches per mile was achieved.

24-foot Pavement

After preparation of the cement treated base, a 24-foot width of class "B" concrete pavement was constructed with the slip-form paver. This machine is similar to the subgrader in appearance and dimensions. In addition to the shoveling device, which in this case was used to spread the concrete, a bank of internal vibrators, a fixed vibratory screed, and two oscillating screeds were suspended from the frame. Side forms extended about 10 feet to the rear. A 24-foot-wide spreader box was towed behind one of the two twin-batch mixers. The mixers dumped directly into this spreader box which sized the proper amount of concrete ahead of the paver.

Two transverse bump cutters were towed along the surface of the concrete directly behind the paver. This double set of vibrating screeds was suspended from a framework which is mounted on and carried by two pans approximately 30 feet apart. The screeds acted as the midpoint of a straightedge, cutting and filling any roughness left by the paver.

On an earlier project, the manufacturer provided two four-inch-diameter aluminum pipes towed by hand to float the top of the fresh concrete prior to the burlap drag. A 10-inch aluminum pipe supported and towed by a motor driven carriage was devised for this project. The pipe was stiffened internally and could be swung in any direction for floating forward or backward and could be

lifted from the surface. The first of two burlap drags was mounted on this machine along with a water nozzle providing a light fog spray.

The finished surface was checked for uniformity with 25-foot-long piano-wire straightedges mounted on small motor-driven tractors for easy maneuverability. Any high or low spots indicated were corrected by cutting or filling and by a final floating with the pipe.

12-foot Pavement

After completion of the initial 24-foot pavement, both the subgrader and the paver were reduced in width to place the additional 12-foot width of base and pavement.

During this operation the left-hand tracks of the paver operated on the surface of the previously placed concrete. Two mixers were used, but it was found necessary to make several modifications before a satisfactory production rate and profile index could be obtained. The number of internal vibrators per foot of width was doubled and the rear tread of the paver was given a slight amount of toe-in so that the rear of the paver had a tendency to push itself toward the other slab. The relative width of the pipe float had to be increased, and it was found necessary to operate it at a more acute angle than on the 24-foot pavement.

Rescreening Aggregates

To insure maximum consistency of concrete, the contractor used an air-entraining agent and rescreened the coarse aggregate at the plant prior to batching. This last was accomplished by blending coarse aggregate in approximately the correct proportions on the tunnel belt and rescreening into two sizes on vibrating screens on top of the bunkers. A small amount of waste material resulted from this method, but better uniformity of the mix was achieved. Little trouble was encountered with the moisture content in fine aggregate, since it was manufactured and stockpiled well in advance of use.



The motor driven carriage finishes the surface with diagonal 10-inch aluminum pipe.

Smoothness Results

The profile index on each days run on the 24-foot pavement averaged under 3 inches per mile. The center of the slab was generally smoother than either of the edges. The majority of the roughness was in low spots evidently due to subsidence of the concrete. It was also found that high or low areas did not usually extend across the slab, nor did starting and stopping the paver appear to induce any additional roughness. The daily profile index on the 12-foot pavement has steadily decreased to a rate now comparable with the 24-foot pavement. Very little grinding of the finished slab appears to be indicated.

Project manager for Westbrook-Morrison-Knudsen is Oliver Pope of Lodi, California. The author is resident engineer for the State and J. M. McDowell is district construction engineer.

Two-county Link

Divided Highway Connects Katella Avenue, Willow Street

By NEWTON H. TEMPLIN, Road Commissioner, Los Angeles County



Completion of the Federal-aid Secondary & Urban Extension project linking Willow Street in Los Angeles County with Katella Avenue in Orange County was highlighted by an unusual ribbon cutting ceremony on May 31, 1962. This highway is an intercounty arterial which now extends from the City of Redondo Beach in Los Angeles County to the City of Anaheim in the County of Orange.

In addition to local, county, city and other dignitaries, delegations from nearby Knott's Berry Farm and Disneyland were on hand to signify the areawide importance of this highway construction project at the ribbon-cutting ceremony, which was held on the deck of the San Gabriel River Bridge. With accompaniment from the Long Beach Municipal Band, the opening of the roadway to traffic was formally accomplished when the familiar old miner's burro from Knott's Berry Farm chewed through the ribbon—and a nearby carrot!



With the aid of a carrot, the burro is enticed to chew through the ribbon and officially open the new divided highway connecting Los Angeles County's Willow Street and Orange County's Katella Avenue. Participating in the ceremony were (left to right) Frank G. Bonelli, Los Angeles County Supervisor; A. S. Koch, Orange County Road Commissioner; Miss Kate Rea; Berry Farm's 'Old Miner'; Mrs. Ella Wallop; Dr. Orville Cole, Long Beach Chamber of Commerce, and Edwin W. Wade, Mayor of Long Beach. The name 'Katella' was made up of the first names of Miss Rea and Mrs. Wallop, both daughters of Orange County pioneer John B. Rea.

Highway Now Continuous

This highway, known as Willow Street in Los Angeles County and Katella Avenue in the County of Orange, is now continuous for a distance of 29 miles and passes through eight cities. Prior to completion of the facility the road was nonexistent between Studebaker Road in Los Angeles County and a point easterly of Coyote Creek in Orange County. The completion of this link now provides a direct connection between the communities on either side of the San Gabriel River and Coyote Creek, including access to the Los Alamitos Naval Air Station.

Southern California residents have long realized the importance of adequate intercounty connections between the Long Beach and harbor areas of Los Angeles County and the western portions of Orange County. However, the need has now become more critical because of the recent development and population expansion within the area. This improvement is a major step in the development of an integrated highway system needed to serve the large industrial, commercial, residential and agricultural centers of these two areas. It will serve to materially alleviate traffic congestion that has developed on parallel routes. The route will provide connections between the future San Diego and the San Gabriel River Freeways, the existing Long Beach and Santa Ana Freeways and the future extension of the Harbor Freeway.

The length of this project is 1.6 miles, with 0.7 mile located within the City of Los Alamitos and Orange County, and the remainder in the City of Long Beach and unincorporated territory of the County of Los Angeles. It consists basically of a four-lane divided highway with shoulders and curbed median. Included are four bridges, two of which are prestressed concrete girder bridges and two of which are reinforced-concrete rigid-frame structures.

The area surrounding the project is relatively low and flat except at the levees of the San Gabriel River and Coyote Creek, which extend some 16 feet above this plane. For this reason, approximately one-third of the roadway was constructed on fill, to a maximum depth of 22 feet.

The roadwork consisted of grading the highway and surfacing with asphalt concrete on cement treated base and constructing miscellaneous drainage structures, median, curb and gutter. The San Gabriel River Bridge and Coyote Creek Bridge are four-span reinforced-concrete deck structures, with prestressed concrete girders. Each bridge is approximately 268 feet long, with two 28-foot roadways separated by a six-foot median and with two sidewalks. The girders were of the pretension type and were fabricated at the casting yard of the contractor.

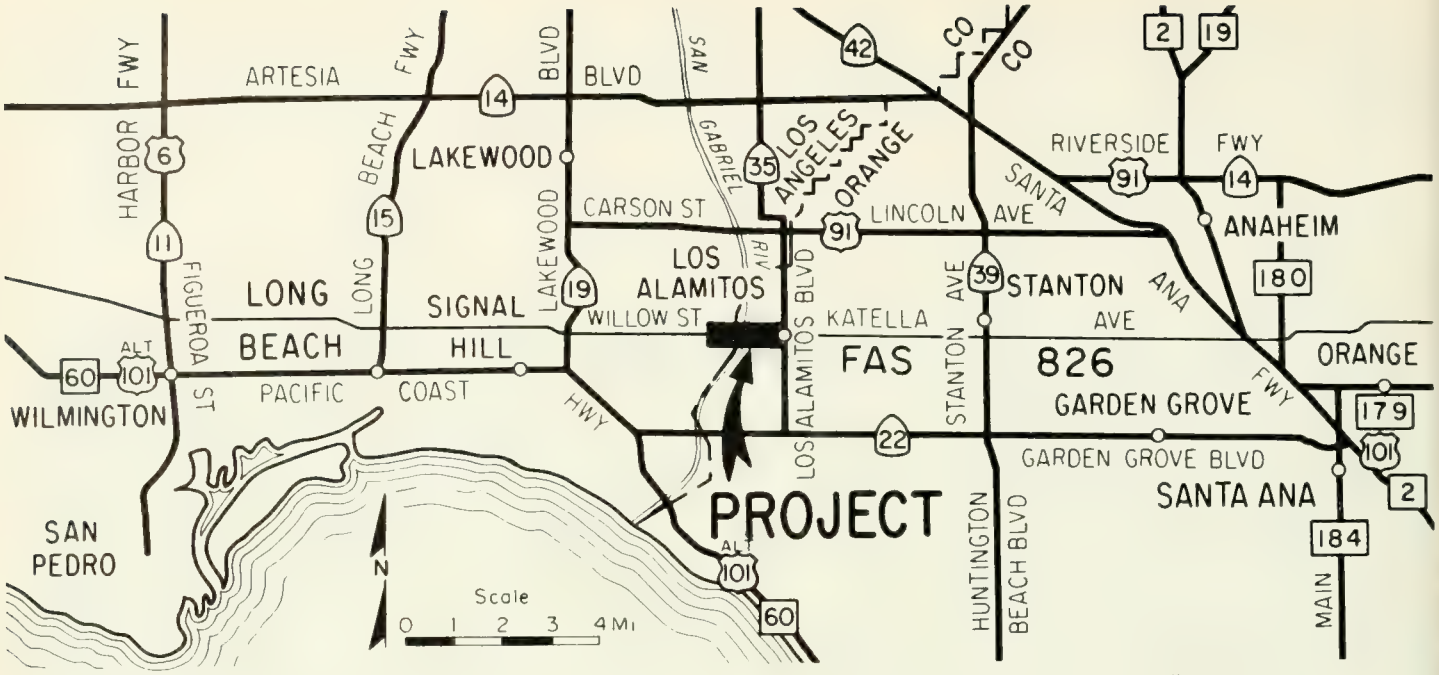
Access Bridges Built

Two single-span access road bridges were constructed within the City of Long Beach portion of the project to serve the multimillion-dollar El Dorado Park, which is currently under development in that area by the city. These structures also provide two 28-foot roadways with median and sidewalks. All of the bridges are pile supported.

The contract was awarded by the State Department of Public Works on June 29, 1961. Work began on July 17, 1961, and was completed and ac-



An aerial view of the new highway looking west from above Katella Avenue in Orange County toward the San Gabriel River and Los Angeles County beyond.



A map showing the location of the new F.A.S. highway on the county line connecting Katella Avenue and Willow Street.

cepted on May 23, 1962—approximately 3½ months ahead of the required date for completion, despite the lengthy and heavy rains which fell in the area during the period of construction.

The total cost of the improvement was approximately $1,236,900. It was financed with federal-aid secondary and state highway funds together with funds from local county and city governments, and was one of the first projects in the Southern California area to utilize the urban extension funds in addition to federal-aid secondary financing. It was also the first intercounty FAS project in the area.

County Co-ordinates Design

By reason of mutual agreement and co-operation between the counties and cities involved, the Los Angeles County Road Department, under the direction of N. H. Templin, road commissioner, co-ordinated the design of the project with the County of Orange and the City of Long Beach. Design of the portions of the project within the County of Orange was performed under the direction of A. S. Koch, road commissioner, and the portion within the City of Long Beach was co-ordinated with the staff of Jess Gilkerson, city engineer. Los Angeles County Supervisors Frank G. Bonelli, of the First District, and Burton W. Chace, chairman of the board's road committee, were particularly active in their support of the project from its inception. The Los Angeles County Road Department provided construction engineering and inspection for the project under the direction of resident engineer Raymond G. Hegwer.

Origin of 'Katella'

An interesting story on how Katella Avenue in Orange County first received its name was related at the ribbon-cutting ceremony. The avenue was first named in about the year 1896, at the same time the Katella School District was formed. It was then a narrow dirt road used mostly for sugar beet trucks and was said to be about "a foot deep with dust." Mr. John B. Rea had two daughters, one named Kate, and one named Ella, so he joined their two names together for Katella. Thas was many years ago but the two sisters Kate (Miss Kate Rea, age 85) and Ella (Mrs. Ella Wallop, age 80) still reside in Orange County and they were present for the dedication of this road project which bears their name.

The successful undertaking and completion of this project involving major highway construction within two cities and the unincorporated territory of two adjacent counties, the obtaining of state and federal aid in connection with the financing of the work, and the resultant economies achieved by reason of being able to combine the individual portions of the highway within the several jurisdictions into one complete project, were made possible only by the ability of several counties and cities to work harmoniously together. It is an outstanding example of what can be accomplished through intercounty cooperation on highways of mutual importance.

SAN DIEGO-HARBOR FREEWAYS

A 4.5-mile section of the San Diego Freeway from Hawthorne Boulevard and 164th Street in Lawndale to a junction with the Harbor Freeway has been opened to traffic. This project completes a 10-mile stretch extending to the Long Beach Freeway in Long Beach.

The southbound lanes of a 4.7-mile section of the Harbor Freeway from 208th Street to the Pacific Coast Highway was opened August 28. The northbound lanes were opened in late September.

Fortuna Project

New Freeway Relieves City's Traffic Congestion

By E. B. THOMAS, Senior Highway Engineer



On July 24 the Fortuna Freeway, extending from two miles south to three-tenths of a mile north of the City of Fortuna in Humboldt County, was completed. This 3.9-mile section of U.S. 101 is a four-lane divided freeway and connects with similar sections previously completed on both the north and the south. It fills in the only gap in 16 miles of freeway, extending from the Robinson Ferry Bridge over Eel River, about two miles north of Scotia, to the old Beatrice Overhead at White Slough, about six miles south of Eureka.

As a further extension of this improved highway, there are currently two other freeway projects under construction just south of Eureka. One is scheduled for completion this year and the other in 1963. These will cover the area from Beatrice Overhead to Eureka and will then complete 35 miles of four-lane divided freeway from Robinson Ferry Bridge to the Mad River, 2¾ miles north of Arcata, interrupted only by the portion through the City of Eureka. Eureka is now served in part by a four-lane street section and in part by a two-street couplet, and no major change to this system is planned in the near future.

Completion of the Fortuna project represents the culmination of many years of work by District I personnel. Some of the original reports concerning the deficiencies of the existing highway dated as far back as 1937.

Right-of-way Acquired

Portions of the right-of-way south of Fortuna were purchased on a conventional basis as early as 1945 and were later converted to freeway by purchasing access rights. The original plan was to widen the existing highway through Fortuna to four lanes. Due to



The new Fortuna Freeway, looking north over the Rohnerville undercrossing. Humboldt Beacon photo.

changing needs and policies in the subsequent years, when the project stood idle for lack of construction funds, the line was reprojected, passing along the westerly side of the city and was established as a full freeway.

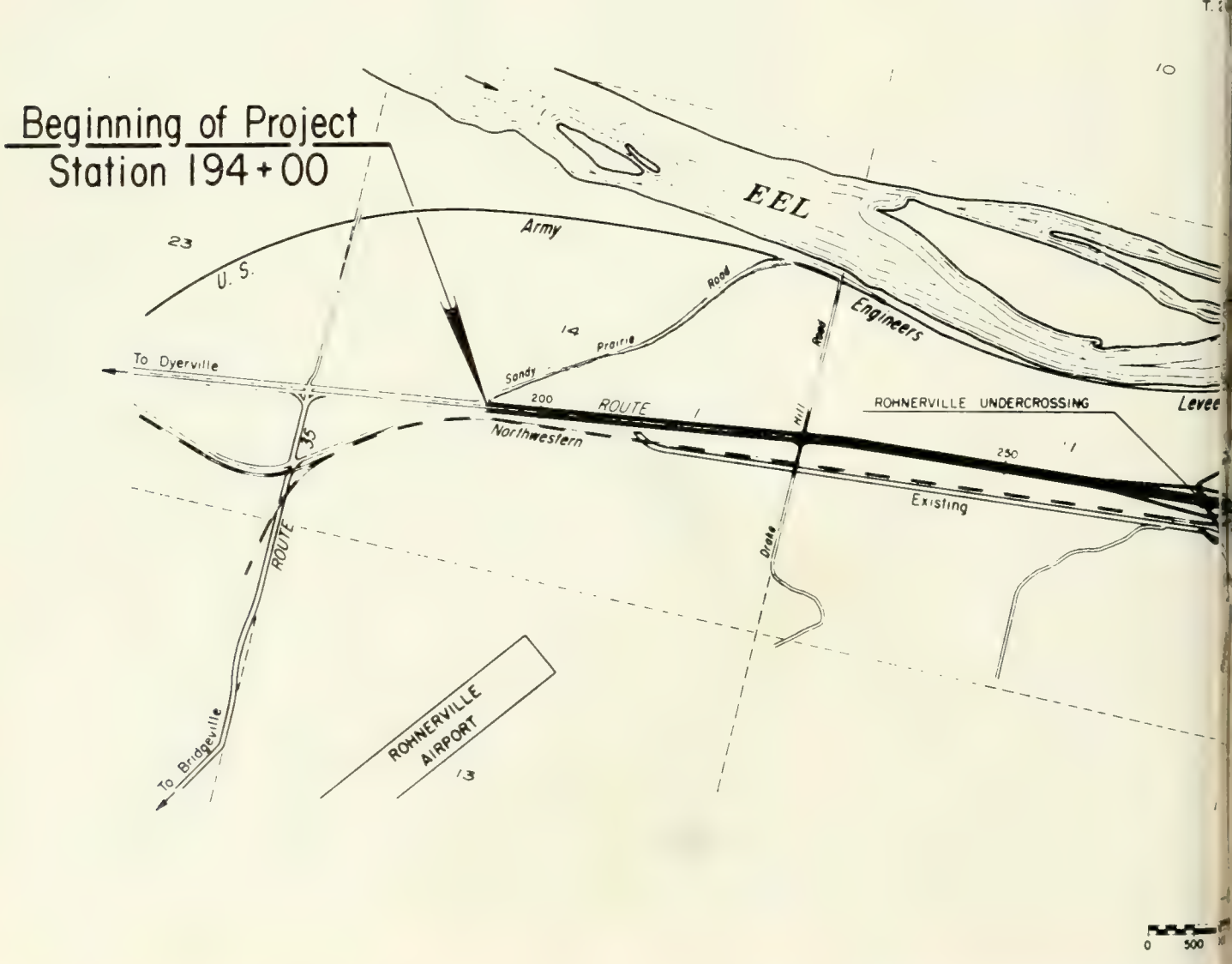
There was originally considerable adverse thinking by local people concerning a bypass of the city, although as traffic problems increased through the years there was a decided change noted in that view point. Considerable thought was given to the situation and the planning was greatly influenced by the results of an external type origin-destination survey made in 1953.

As a result of this planning, access to Fortuna is now conveniently provided at three locations: by the Rohnerville Undercrossing at the southerly entrance to town, the 12th Street Overcrossing near the center of town, and the Fortuna Overhead on the north. The final route was adopted in 1954, and freeway agreements with the city and county were signed the following year.

River Erosion

Serious erosion of the easterly bank of the Eel River during the winters of 1957 and 1958 caused much apprehension over the proposed alignment. During these years the river ate away hundreds of acres of farmland and moved the river bank several hundred feet toward the highway in the vicinity of the planned Rohnerville Undercrossing. To stop further erosion and safeguard our future construction site, the Division of Highways co-operated with the Army Engineers in the construction of the Sandy Prairie Levee, a protection works which extends for approximately 3½ miles parallel to our highway. The State contributed $200,000 toward this levee, which was constructed in 1959-60. This sum represents the actual slope protection value the Division of Highways derived from the project. Construction of this

Map below shows the location of the new freeway which now carries through traffic that formerly used the old highway, here labelled "Existing Traveled Way," through the City of Fortuna.



levee, protecting thousands of acres of valuable land, is, in effect, a "fringe benefit" accruing to the citizens of the Fortuna area as a result of our highway construction, for, without our cooperation and contribution, the Army Engineers would not have gone through with this work.

The erosion which took place prior to construction of the levee was sufficient to necessitate redesign of the Rohnerville Undercrossing. This was originally designed as a trumpet interchange and extended approximately 315 feet into the area washed out by the river. By redesigning this facility as a diamond-type interchange, it was possible to keep most of our construction within the undisturbed area. The only exception is a small portion of a county road connection which skirts the edge of the wash.

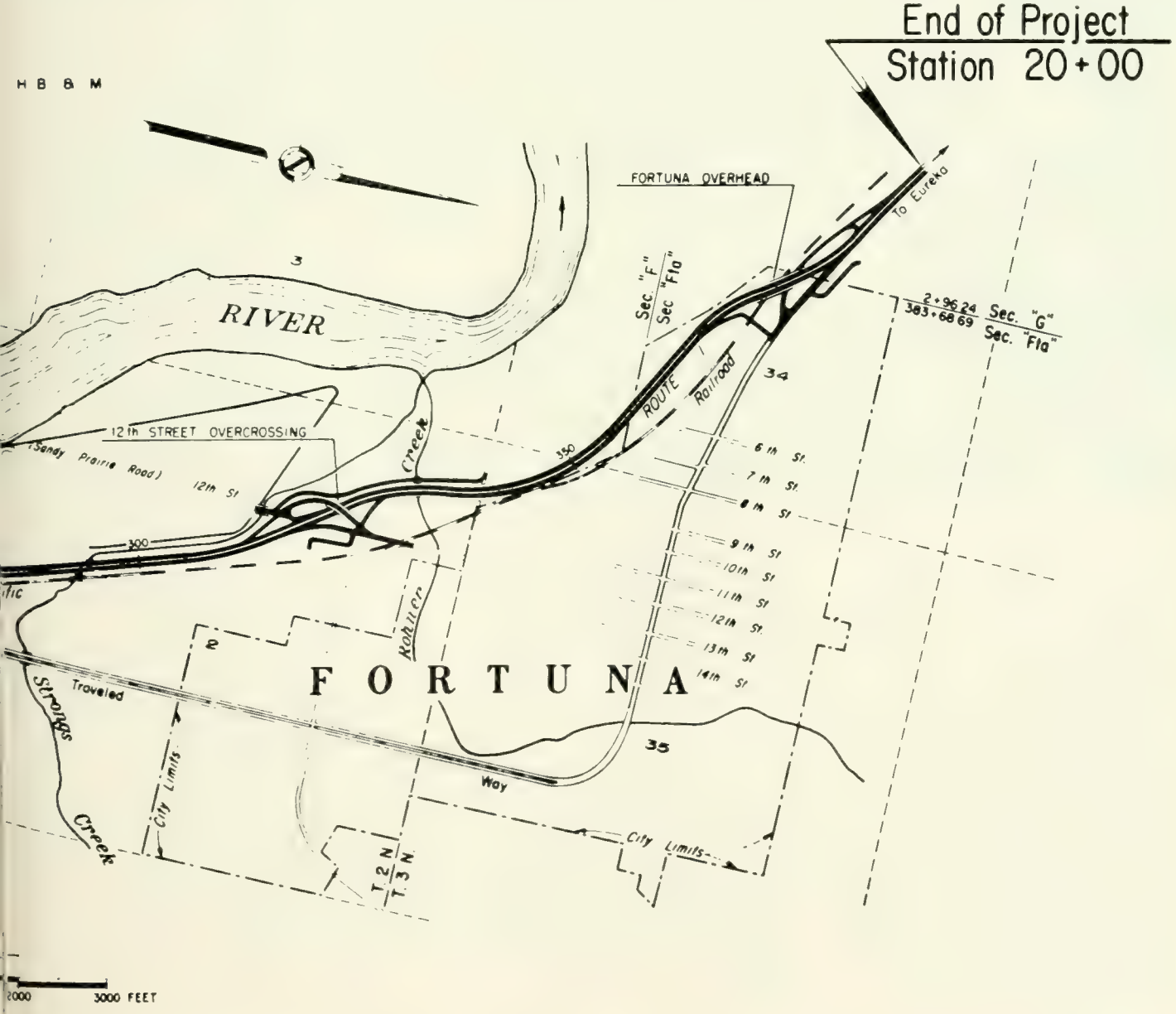
Major Benefits

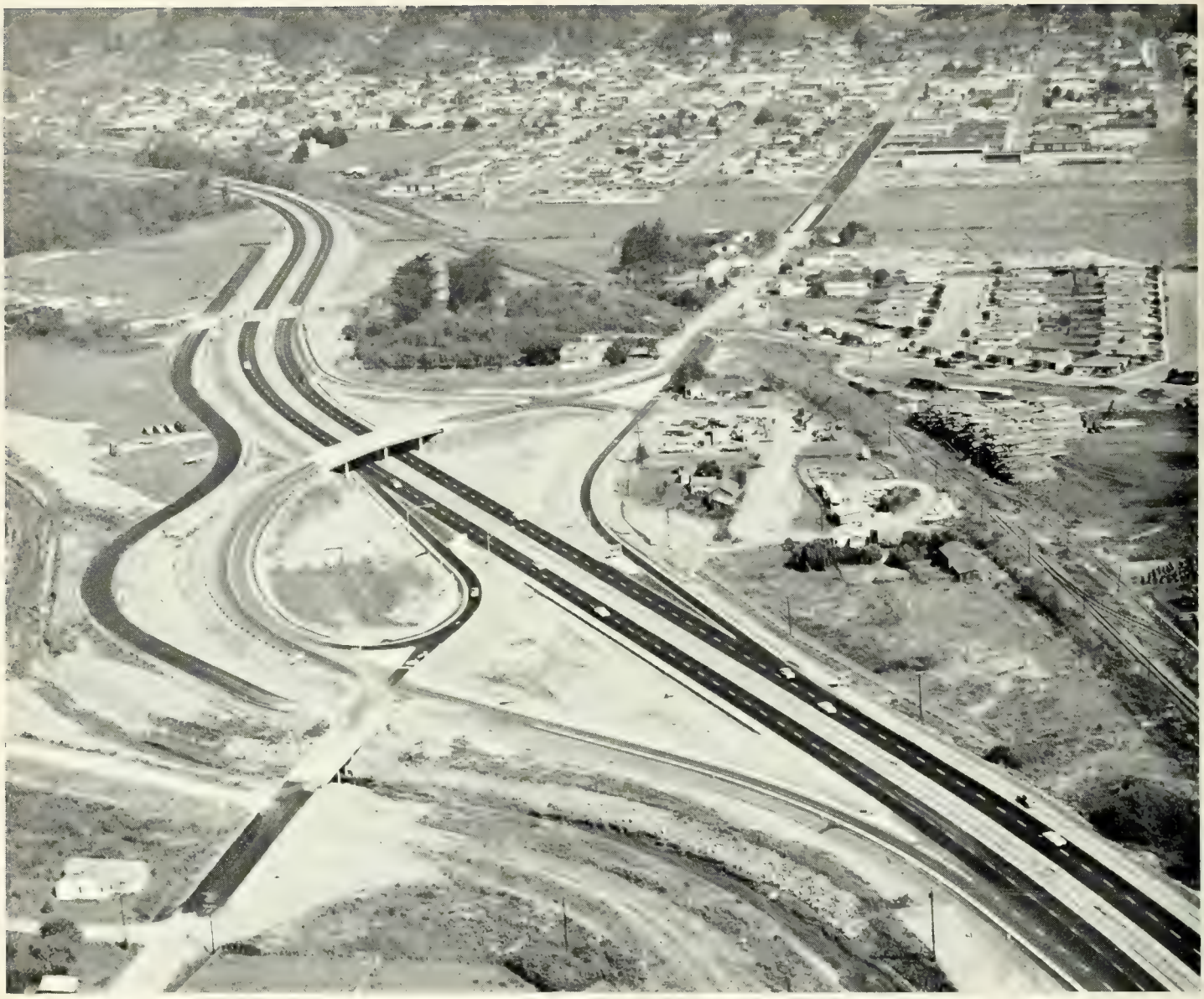
Two of the major benefits which resulted from this improvement are the elimination of the Alton railroad grade crossing and the alleviation of the traffic problem in Fortuna.

At the Alton railroad grade crossing the old highway is parallel and adjacent to the Northwestern Pacific Railroad on both the north and south sides of the crossing. The crossing is accomplished on a reverse curve and is posted for 30 miles per hour. During the period from 1959 to 1962 there have been 32 accidents recorded here, two of them resulting in fatalities and 13 more in injuries. The new alignment eliminates this crossing, remaining on the westerly side of the railroad until north of Fortuna where the crossing is made at the Fortuna Overhead structure.

Shopping Area Congestion

In Fortuna, the old highway followed the main street over a length of approximately two miles. Of this length, about six-tenths of a mile is a 48-foot-wide street through the shopping area with parking permitted on both sides. Although Fortuna is a city of only 3,500 population, it attracts shoppers from many miles, and, with virtually all business centered on





The 12th Street Overcrossing on the new freeway with the City of Fortuna in the background. Humboldt Beacon photo.

the one street, traffic congestion is a major problem. With through highway traffic added to that developed locally, the downtown peak traffic rose to more than 17,000 vehicles per day in summer months, and it was not uncommon to have vehicles backed up for several blocks behind the one traffic signal in town. The new freeway provides immeasurable relief to the downtown area in the way of less congestion, easier parking, smoother traffic flow and added safety.

Actual construction was commenced in September 1961; shortly after the contract was awarded to Clifford C. Bong & Company of Arcadia. The new roadbed lies on the practically level alluvial soils of the Eel River Valley. Grading was very light and presented no problems.

This was primarily a borrow job, there being about 200,000 cubic yards of excavation and over 600,000 cubic yards of imported borrow. Borrow consisted of riverrun gravel obtained from a large bar on the Eel River, adjacent to the project. The borrow was hauled in DW-20's and DW-21's towing large bottom-dump trailers in tandem with their regular scrapers. A Sierra belt loader was used to load both the scrapers and trailers and resulted in maximum loads being attained at all times.

Equipment Damaged

One of the major hazards to this operation, insofar as the contractor was concerned, was the old car bodies and pieces of large bandsaw blades washed down from the lumber mills upstream and buried in the gravel bar. On numerous occasions pieces of this scrap were picked up by the loader and damaged or destroyed the belt, invariably resulting in lost time and considerable repair expense.

Surfacing consists of four inches of asphalt concrete on cement-treated base, and all base and surfacing aggregates were obtained from the same source as the borrow. The various



Congestion on Main Street of Fortuna during July, just before the opening of the new freeway.



Looking north at the Alton Railroad Grade Crossing on the old highway. Note the poor alignment and sight distance.

FORTUNA PROJECT

Concluded

plants required for production of the materials were set up adjacent to the right-of-way, near the center of the job. Mercer Fraser Company of Eureka was the subcontractor on all base and surfacing items.

Chamber Quarterly Features Highways

On the editorial page of the September 1962 State Chamber of Commerce quarterly, *California—Magazine of the Pacific*, the editor points out "Unless a practical working partnership of governmental and private interests can be attained California will be engulfed by its bigness."

This statement sounds the keynote to the special issue, which is intended to bring readers up to date on current highway and transportation advances in the State, as well as to show the problems which must be faced in the future.

More than 90 percent of the issue is devoted to stories on California highways and transportation, representative titles of which include "Freeway Planning," "Right of Way," "California's Highway Commission," and "Freeways and Community Development."

BRIDGE TRAFFIC INCREASES

In the first two weeks since its mid-September opening, the Benicia-Martinez Bridge has carried more than 4,000 vehicles a day on weekdays and many more on weekends, despite the fact that the freeway approach on the Contra Costa side is still under construction and bridge traffic must still use a two-lane connection in the Martinez area. On September 16, a total of 12,232 vehicles passed through the tollgates. The ferry which the bridge replaced carried an average of fewer than 500 cars a day during August, its last month of operation. The heavy traffic using the bridge was hailed as auguring well for the economics of Contra Costa and Solano Counties.

Ventura County Freeways

By E. T. TELFORD, Metropolitan District Highway Engineer



Ventura County, an area of rugged mountains, vast ranch lands and a beautiful seacoast, is growing with the rest of Southern California. Light industrial expansion with subdivisions, business and services that commonly attend the influx of population are transforming the county into a key community, making it a part of Southern California's booming metropolitan economy.

Accessibility and availability of space are two of the most important attractions of the county, making the shift by industry and commerce from the adjoining crowded urban complexes advantageous; for the residents and personnel manning local industry and business, there is the refreshing prospect of country living in a temperate climate, where mountain and beach recreation areas are practically next door.

Interesting Phenomenon

The growth of Ventura County in terms of population statistics is an interesting phenomenon as told by John D. Tapking, Planning Director, Ventura County Planning Department:

"The population of Ventura County on July 1, 1962, was 234,360, almost 19,000 more than one year ago and over 35,000 above the April 1, 1960, census figure. Based on the population as of July 1, 1961, the present annual rate of growth is 8.8 percent, a substantial increase over the 6.5 percent annual rate of growth that occurred in 1960 and the 73.7 percent total increase that took place between 1950 and 1960. This present high rate of growth, which gives no indication of having reached a plateau, places Ventura among the fastest growing counties in California.

"The 10 planning areas of Ventura County are experiencing widely divergent rates of growth. This is, in part, because of the proximity and economic influence of the Los Angeles metropolitan area which has helped accelerate development in the southeastern portion of the county as well as stimulated growth throughout the whole county. The Simi area, for example, is currently growing at a rate of over 36 percent and has almost doubled in size since the 1960 census. The Conejo and Camarillo areas are also rapidly developing with growth rates of over 15 percent and 12 percent respectively."

Annual Growth Rates

Ventura County growth rates, on an annual percentage basis between July 1, 1961, and July 1, 1962, for the various planning areas are given as follows: Camarillo, 12.5; Conejo-Coastal, 15.9; Moorpark, 10.5; Ojai, 8.2; Oxnard, 7.9; Santa Paula, 2.5; *Simi*, 36.6; Ventura, 6.7.



Calleguas Creek Overcrossing under construction on Pacific Coast Highway in the vicinity of Point Mugu.



Ventura Freeway construction, looking eastward from the west end of the job. Note the benched slope to the left of the highway.

The six cities of Ventura County are also gaining in population, as illustrated by the following table:

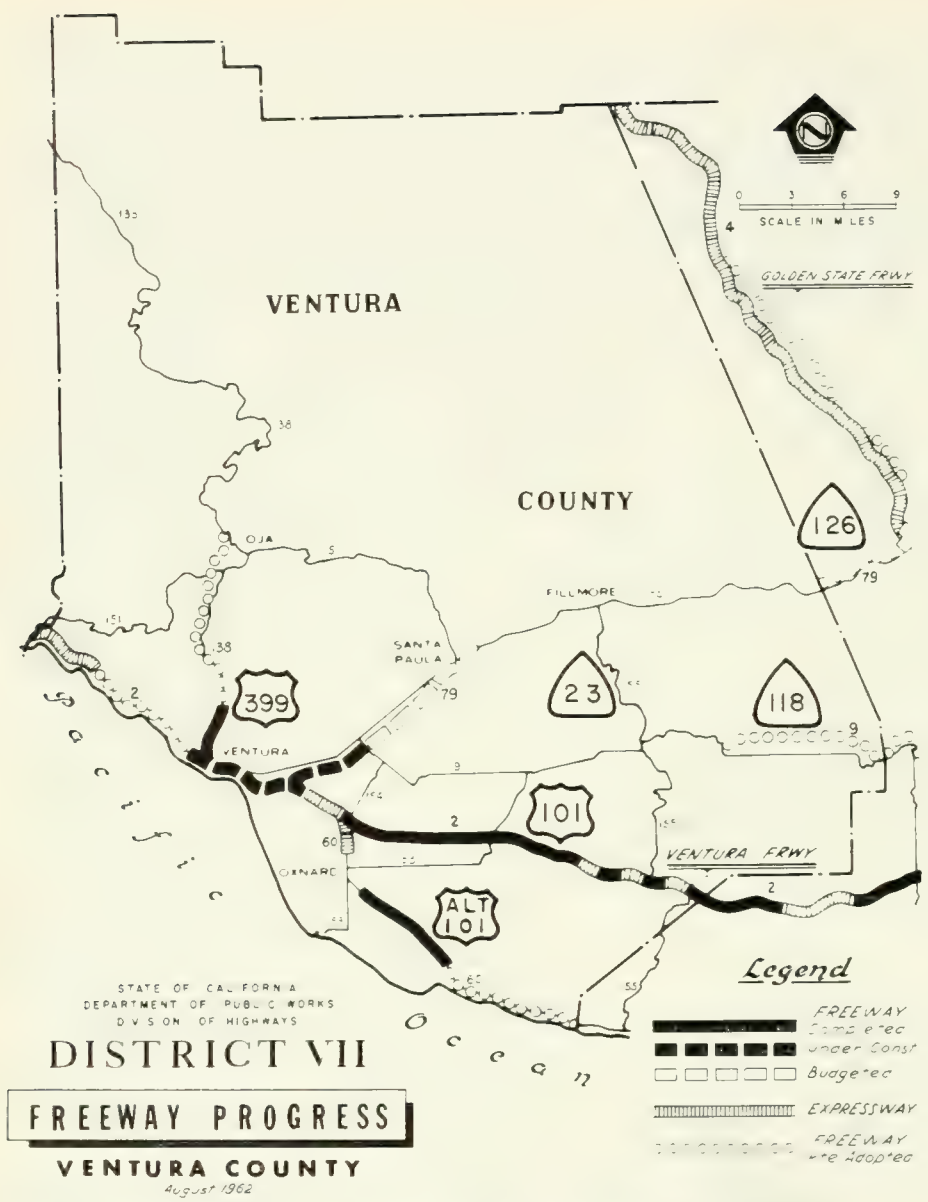
Rank	City	Estimated population July 1961	July 1962	Rate of growth
1	Oxnard	42,200	47,037	11.46%
2	San Buenaventura	30,621	32,728	6.88%
3	Santa Paula	13,932	14,294	2.60%
4	Port Hueneme	11,763	12,583	6.97%
5	Ojai	4,804	5,211	8.47%
6	Fillmore	4,838	4,851	.27%

County Roads

Ventura County Road Commissioner C. G. Smith, succeeding the retiring J. V. Kimber, reports that as of August 1962 outstanding contracts in progress on county roads amounted to more than $250,000 and represented various improvements on such routes as Ventura Boulevard, Victoria Avenue Extension, First Street (Simi), West Road, Royal Avenue, Ventura Road Extension, Cochran Street Bridge, Katherine Street Bridge, Hilmont Road, Ventura Boulevard and Tico Road. County road mileage has advanced from 705 in June 1960 to 753 as of March 1962. The major source of county funds for local roads is the state-collected and distributed fuel and in lieu tax and traffic fine revenues, amounting to $2.1 million per annum. These moneys are being invested to best advantage by Ventura County in building its road network.

Since 1956 the State Division of Highways has expended in excess of

Seattle Public Library
NOV 23 1962



Location of freeway planning and construction and their current status is shown in the above map of Ventura County.

$25 million on freeways in Ventura County, including rights of way and construction. An August 1, 1962, breakdown indicates 19 miles of completed freeways and 20 miles of expressways in operation, with 13 miles under construction. The county has 274 miles of constructed state highways of all types and 101 miles of adopted freeway routes. Division of Highways plans, as set forth by Senate Bill 480, 1959 California Legislature, are projected forward to the year 1980, when an estimated $291.1 million will have been invested in 199 miles of freeways in Ventura County. This investment will be reflected in highway user and traffic benefits for twice the current population (234,360, July 1, 1962) and twice the present motor vehicle registration (112,463, June 30, 1962).

Ventura Freeway

The 32 miles of Ventura Expressway from the Los Angeles-Ventura county line to the Ventura Overhead is being converted to full freeway standards as fast as funds become available and plans can be prepared. This conversion consists of grade separation structures either over or under the present expressway together with interchange ramps and frontage roads and the closing of all entrances and exits from the freeway except at interchanges.

Telephone Road—Palm Street

The Ventura Freeway is under construction at two locations within the City of Ventura. The most easterly project extends from Telephone Road to Palm Street, a distance of 4.6 miles, and is being constructed under $9,148,400 contract. Actual work began on March 14, 1960. The estimated completion date of this stretch of the Ventura Freeway is the latter part of October 1962, with stage opening to traffic a little earlier. Ribbon-cutting ceremonies were held by the Ventura Chamber of Commerce on September 27. The six-lane facility will have eight bridges and one pedestrian overcrossing. When completed, the freeway will have temporary connections at the westerly end of the city, at existing U.S. 101, with east and westbound ramps at Oak Street and California Street, pending construction of the connecting freeway link to the west.

The east portion of the job is built on imported borrow originating from the Ventura Port District Small Boat Harbor, two miles distant. 2,700,000 cubic yards of material was secured from this site under difficult conditions utilizing dragline and bottom-dump trucks, followed by push loading with scrapers. In addition to building a haul road, the contractor sank 28 wells around the edge of the excavation to a depth of 50 feet and pumped out the ground-water seepage. This operation was on a round-the-clock basis, lasting 1½ years.

Drainage Facilities

Some of the drainage facilities constructed to handle existing barranca runoff include a 16-foot field-assembled structural plate pipe 626 feet in length at Arundell Barranca near the Sign Route 126 Freeway interchange; a 14- by 9-foot structural plate pipe arch 526 feet long, cambered because of area of extreme settlement; and an 8-foot structural plate pipe 392 feet long paralleling the Southern Pacific Railroad at Lemon Overhead.

Other incidental work centered around ramps and frontage roads. Telegraph Road was realigned and widened to four lanes for some 800 feet.

Seaward Avenue was similarly treated, having been converted to a four-lane overcrossing in an 1,800-foot section. Shore Drive was eliminated from San Pedro Street to San Jon Road, a distance of 3,500 feet, and replaced by a modern frontage road. Chestnut Overhead over the freeway and railroad was converted into a southbound freeway connection from Meta Street.

Among the other construction complications was the relocation of a 24-inch main city sewer at Front Street to a new location opposite the freeway and crossing it at Oak Street. The area adjacent the beach bluffs was a natural water storage basin and had to be replaced with a like installation with a pumphouse at San Jon Creek.

Major construction problems were encountered in the two cut sections at the middle and west end of the job, where ground water was present within five feet of the land surface. The subgrade was in clayey silt and free ground water.

In order to stabilize this condition, the contractor excavated to 2.5 feet below the subgrade and replaced existing material with pervious sand—an extremely difficult and expensive operation. The contractor also installed subterranean gravity perforated metal pipe in an extensive drainage network in the downtown section of the freeway. Here, too, 1,500 feet of solid retaining wall was erected because of adjacent buildings and the limited right-of-way width.

Surcharge Settles

During construction the surcharge for bridges in embankment areas began to settle. At Telephone Road, Main and Lemon Streets the slump reached as much as 2.7–3.2 feet during surcharge settlement periods. The adjacent recreational area along Shore Drive on the beach was improved by freeway construction, since 80,000 cubic yards of excess excavation was placed here in first stage construction of this park, covering an area approximately 2,500 feet long by 800 feet wide.

Construction detouring of traffic on busy U.S. 101 Highway through the city was necessary at Telephone Road and Main Street. However, the opening to traffic of the new freeway will permanently divert existing heavy traffic from old U.S. 101, giving appreciable relief to local and through traffic, besides affording a pleasant prospect of Ventura's orchard, shore and mountain beauties.

This portion of the Ventura Freeway was paved in part with a slip-form paver which laid the concrete in 36-foot widths, or three freeway lanes at a time, completing runs as long as 1,600 and 1,700 feet in a single working day with a comparable amount of yardage. It should be noted that a satisfactory degree of pavement smoothness was also achieved in the fast-moving operation, which utilized the central mix method of supplying the paving train.

Palm Street—Ventura Overhead

On February 28, 1961, work began on three miles of the Ventura Freeway from Palm Street, the end of the contract to the east, and the Ventura Overhead bridge at the entrance to Emma Woods State Park, where connection will be made with existing U.S. 101. Part of the project involves construction of one mile of the Ojai Freeway (U.S. 399) and full interchange with the Ventura Freeway, eliminating a hazardous at-grade intersection at U.S. 101. Both projects are under $7,757,400 contract scheduled for completion in May 1963, though the Ventura Freeway section may be



The freeway and expressway system established for Ventura County by Senate Bill 480 is shown in the above map.

opened to traffic as far west as Taylor offramp by early November 1962.

In all, 10 bridges and one pedestrian undercrossing at Ventura Avenue will be built. The longest bridge, 977 feet, will span the Ventura River. Two other bridges, Garden and West Ventura Overheads, will cross the Southern Pacific Ojai line.

Garden Street was widened for 1,000 feet to provide a suitable entrance to the 31st Agricultural District Fairgrounds (Seaside Park); Front Street, another entrance to Seaside Park, was improved for 1,500 feet; and 700 feet of Beach Street was constructed along the waterfront. At Peking and Harriet Streets a city dump was uncovered during initial grading operations and 50,000 cubic yards of unsuitable material distributed in the fills. The hauling of fill materials for the job was accomplished without interference to traffic by means of a state easement, allowing the contractor to make use of a state-owned haul road.

Major Slide

A major 1,000,000-cubic-yard slide in September 1961 at the westerly end of the project from the freeway cut slope resulted in a serious design and construction problem. At an estimated additional cost to the State of $1 million, basic design was altered and provision made to raise the original freeway grade level 60 feet over a one-mile stretch at the west limits of the project. Design engineers and geologists deemed this the most feasible corrective measure, which would also tend to buttress the unstable north slope. Hence the freeway cut, 250 feet high before the slide, was laid back on a 2- to 1-foot slope; so that what was originally to be a sag between project limits will now be a vertical curve at 2.5 percent grade.

Borchard Road Interchange

The $536,000 Borchard Road interchange is one of a series of projects in Los Angeles and Ventura Counties, which will convert the present Ventura Freeway to full freeway standards, eliminating intersections at grade. This project is located in Newbury Park, another boom area in Ventura County.

The work, started on May 24, 1961, and now completed, consisted of approach roads, frontage roads, ramps and a steel girder bridge carrying Ranch Conejo Boulevard–Borchard Road over the freeway; also the widening of the existing reinforced concrete slab bridge over Arroyo Conejo Creek. The interchange is essentially a two-quadrant cloverleaf with westbound and eastbound on- and offramp connections. In addition to the bridge and approaches, a structural section of existing Ventura Freeway was reinforced with four inches of asphalt concrete on top of old portland cement concrete and the shoulders built up. This work was done on the eastbound roadway, from Conejo Summit eastward for a distance of 3,500 feet. This construction necessitated detouring of Ventura Freeway traffic to westbound lanes in a three-mile section. Every effort was made to minimize inconvenience to the traveling public and the detour was discontinued after a period of two months.

On September 6, 1962, the Newbury Park Chamber of Commerce dedicated this important interchange at special ceremonies.

Moorpark Road Interchange

Serving the community of Thousand Oaks and proceeding in a generally north-south direction, Moorpark Road is being revamped and separated from the Ventura Freeway, its present terminus. Work underway since August 21, 1961, under $1,621,746 contract calls for the construction of a grade separation at the Ventura Freeway, the widening of existing Conejo Creek Bridge and the reconstruction of Moorpark Road to a four-lane divided facility as far as Olsen Road, a distance of 3.7 miles. When completed in mid-December of this year, Moorpark Road (presently measuring 17 and 22 feet in width) will have a 32-foot paved roadway in each direction with a curbed 16-foot median and left-turn pockets. The roadway pavement will measure four inches in thickness.

The first order of work was to prepare Moorpark Road for detouring and temporary widening, followed by construction of a ¾-mile detour to handle Ventura Freeway traffic. With traffic using the two-way bypass section and the temporary connection with Moorpark Road, work proceeded on the Ventura Freeway bridge structure and approach roadways. The Ventura Freeway was widened from four lanes to six for ¾ mile, with provision to complete the eastbound roadway first. This work has since been completed and the new pavement will be striped to accommodate on a temporary basis both outbound and inbound Ventura Freeway traffic, at which time construction can proceed on the north freeway roadway. Completion of this structure will provide a diamond interchange with Moorpark Road, permitting on and off movements for eastbound and westbound freeway traffic.

As of this writing, the southbound roadway of Moorpark Road is completed and has been in use to both northbound and southbound traffic while the other half of the roadway is being completed. This important facility as well as the main line Ventura Freeway have both been kept in service to through and intersectional traffic during construction under elaborate detour conditions.

Water Feeder Line

An interesting feature of this project has been the concurrent installation of a 30- and 24-inch steel-lined concrete water feeder line by the Calleguas Municipal Water District under state utility encroachment permit. This line, passing through the median area of Moorpark Road, from Olsen Road to Village Lane, stretches three miles through the job and is part of a $22,000,000 water improvement project designed to serve the water needs of Conejo Valley until 1975, when Feather River water will be made available. Thus, burgeoning Conejo Valley will very shortly receive the added stimulus of a stable and ample water supply from the Metropolitan Water District. This new line will principally supply the fast-growing residential and light industrial expansion in the area, relieving the demands on well water which has become increasingly scarce.

In addition to the aforementioned water main, other water lines and utilities had to be accommodated in the construction area. These included gas mains, crude oil lines, power and telephone overheads.









PHOTO ABOVE LEFT—The recently completed four-laning of Saviers Road, looking north from Bard Street. ABOVE RIGHT—Looking west along Hueneme Road, a recent improvement in the Hueneme area. Four-lane highway joining the near end of the project (right to left) is Saviers Road. BELOW LEFT—The Moorpark Road improvement in Thousand Oaks looking north from the Ventura Freeway under construction (foreground). LOWER RIGHT—The Borchard Road-Ventura Freeway Interchange in the Newbury Park area.



The Ventura Freeway will pass over Moorpark Road on this interchange structure now under construction.



Looking south along the Las Posas Federal-Aid Secondary Road project. At left is Laguna Peak near Point Mugu.

Unusual success was achieved with the slip-form paving apparatus, which laid 12-foot and 24-foot sections of concrete on the Ventura Freeway section of the project. Measurements taken by the profilograph indicated an especially smooth pavement surface of a high of 2.16 inches per mile and a low of 0.48 inch.

Other Interchanges

Tentatively scheduled for the near future are an interchange at Hampshire Road together with an undercrossing at Live Oak Road (estimated cost for the two is $675,000); an interchange at Newbury Park ($750,000); and an interchange at Old Conejo Road ($470,000).

During the 1962–63 construction year, interchanges and frontage roads will be constructed at Triunfo Road ($495,000); at Geneive Street just west of Camarillo ($475,300); and at Central Avenue and Garden Acres, together with a pedestrian overcrossing at Occidental Drive ($950,000).

Upon completion of all this work, U.S. 101 will be full freeway from the Los Angeles county line to Vineyard Avenue just east of Ventura, except for one location at Cunningham Road which has been temporarily deferred in order to co-ordinate the design with the Moorpark Freeway for which public hearings are now being held.

Construction will also get under way within the next two to four years, depending on the availability of funds, on a project for converting the four-mile length between Vineyard Avenue and Telephone Road to full freeway.

Six bridges will be required, four of which are major structures. A proposed bridge for the westbound roadway across the Santa Clara River will be 2,000 feet in length, and separation structures will be constructed at two locations over the Santa Paula branch of the Southern Pacific Railroad; also, an interchange at Victoria Avenue. U.S. 101 Alternate will be carried over both roadways of the Ventura Freeway in lieu of the present bridge over the eastbound roadway. Approximately 1,100,000 cubic yards of imported borrow will be required for embankment. The total cost is estimated at $7,000,000.

Construction will also be underway within the next few years for modification at the interchanges at Rice Road–Santa Clara Avenue and at Rose Road–Ditch Road at a cost of $350,000, and for construction of a separation structure at Cunningham Drive at a cost of $300,000.

Completion of these projects, together with the Agoura Road interchange in Los Angeles County, which is tentatively scheduled to be underway at about the same time, will provide a full freeway between downtown Los Angeles and the City of Ventura.

Ventura-Santa Barbara County Line

Northwest of Ventura from the existing Ventura Overhead, the future Ventura Freeway will be on the landward side of the Southern Pacific tracks as far as the Chanslor Oil Refinery at Seacliff, where the alignment crosses over the tracks and goes out into the ocean for one-half mile to avoid the refinery.

North of Seacliff the freeway will follow the alignment of the present four-lane divided highway to a point one-half mile south of the Santa Barbara county line where it will join a freeway project presently being designed in District V.

For the length from the Ventura Overhead to one-half mile south of the Santa Barbara county line, approximately 3,000,000 cubic yards of excavation and 4,000,000 cubic yards of embankment will be required.

Separation structures with interchange ramps will be provided at Seacliff and at Mussel Shoals; also five small road separation structures. Total cost is estimated at $9,000,000. Construction may start on the first portion, including the section at Seacliff out in the ocean, within the next three to four years, subject to the availability of funds.

Sign Route 126 Freeway

First construction on the Sign Route 126 Freeway, paralleling Telephone and Telegraph Roads in Ventura County, began on August 29, 1961, on a 5.4-mile section linking the future Ventura Freeway with Wells Road. The $3,922,222 project, the estimated completion date for which is May 1963, calls for an initial four-lane construction with provision for an ultimate six lanes. The completed facility will have six bridges and one pedestrian overcrossing which is a prestressed-in-place structure. A massive 14- x 14-foot reinforced-concrete box at Harmon Barranca will constitute a farm undercrossing for pedestrian and vehicular traffic on abutting ranch lands.

The most interesting feature of this at-grade freeway is the drainage system which consists of five miles of four-inch gunnite channel for on- and off-site drainage flanking the north side of the freeway, amounting to 3,200 cubic yards. Two 168-inch structure plate pipes 270 feet and 128 feet in length pass under the freeway at Harmon and Arundell Barrancas for the uninterrupted drainage of these channels. On the east end of the job, Wells Road was relocated as a detour for one-half mile to permit construction of the Wells Road overcrossing. When the Sign Route 126 Freeway is completed and opened to traffic, Telegraph Road (the present state highway) will be improved for permanent relinquishment to Ventura County.

Planning

The Sign Route 126 Freeway begins at the Montalvo intersection and extends easterly into Los Angeles County where it makes connection with the Ridge Route, or the Golden State Freeway. Its total length in Ventura County is aproximately 36 miles. A 14-mile portion between Montalvo junction and Orcutt Road in Santa Paula is presently adopted and the remaining 22 miles is currently under study with a target date for adoption in late 1963.



The Victoria Avenue overcrossing and cloverleaf on Sign Route 126 in Ventura



This drainage channel flanks the Sign Route 126 Freeway.

Design

Plans are nearly complete and bids will be called for early in 1963 for an 8.5-mile extension of the Sign Route 126 Freeway from Wells Road to Santa Paula. The proposed freeway is on new alignment south of Telegraph Road–Harvard Street. Six miles of the length is in county area and 2.5 miles through the City of Santa Paula. Fifteen structures will be built. The project is budgeted at $7,000,000 in the current 1962–63 fiscal year.

Ojai Freeway

Preliminary plans for an Ojai Freeway project between Mills School and Foster Park are well along. Starting from a point one-fourth mile south of the present grade crossing with the Ojai branch of the Southern Pacific (south of Mills School), the freeway will pass over the railroad and continue to Foster Park, south of the present highway along the base of the mountains.

Separation structures will be required over the railroad and over Ventura Avenue, and complete interchanges at Canada Larga Street and Casitas Pass Road.

Construction may get underway within the next five years, depending upon the availability of funds. Construction is estimated at $2,800,000 and right-of-way at $800,000.

The Highway Commission, on May 23, 1962, adopted the route for the Ojai Freeway between Foster Park and Cozy Dell Canyon northwest of Ojai.

The adopted route follows, in general, the east bank of the Ventura River. The Ojai branch of the Southern Pacific will be moved at four locations and crossed once on structure. Embankment on the west side, adjacent to the Ventura River, will be protected by riprap or other embankment protection. The location of grade separations and interchanges have not yet been determined.

The length of this second project will be 8.4 miles; cost is estimated at $9,900,000 for construction and $2,400,000 for right-of-way.

When completed in future years, the Ojai Freeway (U.S. 399) will extend 57 miles from the City of Ventura to the Santa Barbara county line. As yet no route location studies are in progress on the route north of Ojai.

Pacific Coast Freeway

A section of the Pacific Coast Freeway in Ventura County has been completed since 1957 when 6.8 miles of the route was opened to traffic between Calleguas Creek and Date Street, at a total cost of $2,413,000. The overall length of the Pacific Coast Freeway (U.S. 101 Alternate) in the county is 21 miles between the Los Angeles county line near Malibu and El Rio. The entire route is adopted except for a four-mile stretch between the south city limits of Oxnard and El Rio, which is currently under study with a target date for adoption in mid-1963. The southernmost nine miles of the Pacific Coast Freeway in the county is also under study by the Division of Highways, for relocation and possible re-adoption in 1963.

Calleguas Creek Overcrossing

Since April 11, 1962, a project has been underway to construct an overcrossing on the Pacific Coast Freeway at Calleguas Creek, seven miles southeast of Oxnard. This facility, in addition to Wood Road overcrossing and a pedestrian overcrossing to the west, will provide further vehicular access for the U.S. Naval Test and Missile

Center, which spans the freeway. The $[illegible] project, a three-quadrant interchange with east- and westbound ramp connections and four bridges, will be completed in late November of this year.

Other Road Projects

Besides work completed and in progress on major freeway links, interchanges and separation structures in various sections of Ventura County, a number of minor projects on state and local roads are also getting attention. This is a continuing policy of the State Division of Highways—keeping California's existing secondary and feeder routes in good repair and building new improvements where these will contribute to the safe and efficient movement of people and goods.

Some of these projects are listed briefly as follows: Las Posas Road extension between Laguna Road and Pacific Coast Freeway, 4.1 miles, a new two-lane facility under $[illegible] contract scheduled for completion in November 1962. Santa Susana Pass Road and Los Angeles Avenue Roads, four miles, conversion of existing two-lane facility to four-lane divided highway with left-turn channelization, a $[illegible] project already completed. Santa Susana Pass Road at the Los Angeles–Ventura county line, 2.7 miles grading, surfacing and realignment, a $[illegible] project scheduled for completion in October 1962. grading and surfacing of 1.5 miles of various routes, a $[illegible] project already completed. Telegraph Road at Ashwood Avenue and Seaton Road, 0.1 mile; signals, lighting and channelization, a $[illegible] project already completed, also, bids were opened in August from a budgeted $[illegible] for signals, lighting and channelization at Vineyard Avenue and the Ventura Freeway, and at Oxnard Boulevard and Pacific Coast Highway.

Simi Valley Freeway

The Simi Valley Freeway, State Sign Route 118, begins at State Sign Route 126 near Saticoy and extends eastward to the Los Angeles county line, a distance of about 16 miles. The easterly nine-mile portion of this route between Madera Road in the Simi Valley and the Los Angeles county line has been adopted. The remaining 7.0 miles



Looking west along the paved roadway of the Ventura Freeway toward the Southern Pacific Simi line overhead.



Construction on the Ventura freeway near the west city limits of Ventura. The embankment at the right was a slide area. Cars drive along present [illegible] at the center of the photo.



Ventura Freeway construction through the City of Ventura. The view is eastward. The Ventura River and bridge is center and, just beyond, the Ojai-Ventura Freeway Interchange.

is currently under study with a target date for adoption in late 1963.

Santa Paula Freeway

The Santa Paula Freeway (State Sign Route 150), begins at Rincon Point just north of the Santa Barbara county line and joins State Sign Route 126 in Santa Paula via Ojai. There are no current studies under way at this time as to the ultimate location of this freeway.

Calleguas Freeway

The Calleguas Freeway, portions of which bear State Sign Route 34, extends from the City of Hueneme to State Sign Route 118 near Somis, a distance of some 14 miles. A short length of this freeway between Hueneme and Oxnard is under study in conjunction with the Pacific Coast Freeway between Oxnard and El Rio.

Moorpark Freeway

The Moorpark Freeway (State Sign Route 23), begins at the Ventura Freeway near Newbury Park and joins State Sign Route 126 in Fillmore via Moorpark. Its total length is 16 miles. A California Highway Commission hearing was held on September 19, 1962, in Thousand Oaks, following a district public hearing in January 1962 to discuss route study location results of a seven-mile portion of the Moorpark Freeway lying between the Ventura Freeway and Tierra Rejada Road. Data on three basic lines for the future freeway was presented, with estimated construction and right-of-way costs ranging from $22.1 million to $23.3 million.

Spencer Cortelyou

After enjoying 13 years of retirement—preceded by 38 years of state service—Spencer V. Cortelyou died August 9 at age 83, in Claremont. Mr. Cortelyou, who had been Assistant State Highway Engineer in charge of District VII, was one of the leaders in the development of the freeway concept which resulted in the construction of California's first freeway —the Arroyo Seco Parkway between Los Angeles and Pasadena (now known as the Pasadena Freeway), opened December 30, 1940.

Mr. Cortelyou was affectionately known as "Father of the Freeways," having actively participated in the many studies leading to the freeway system in the Los Angeles metropolitan area. Prior to his retirement in 1949, location, design, and construction were well under way on the "backbone" of the Los Angeles freeway system: the San Bernardino (then known as the Ramona), the Hollywood, the Santa Ana, and the Harbor Freeways.

As one of the original employees of the California Division of Highways, Mr. Cortelyou started as Principal Assistant to Division Engineer W. Lewis Clarke on February 1, 1912, in District VII, which claimed his entire career of distinguished state service. (Districts were then called divisions; and District VII originally included the Counties of San Bernardino, Riverside, Imperial and San Diego—as well as its present three Counties of Los Angeles, Orange, and Ventura.)

As a young man, he graduated from the University of Nebraska in 1902, where he gained recognition equivalent to "All American" honors in football.

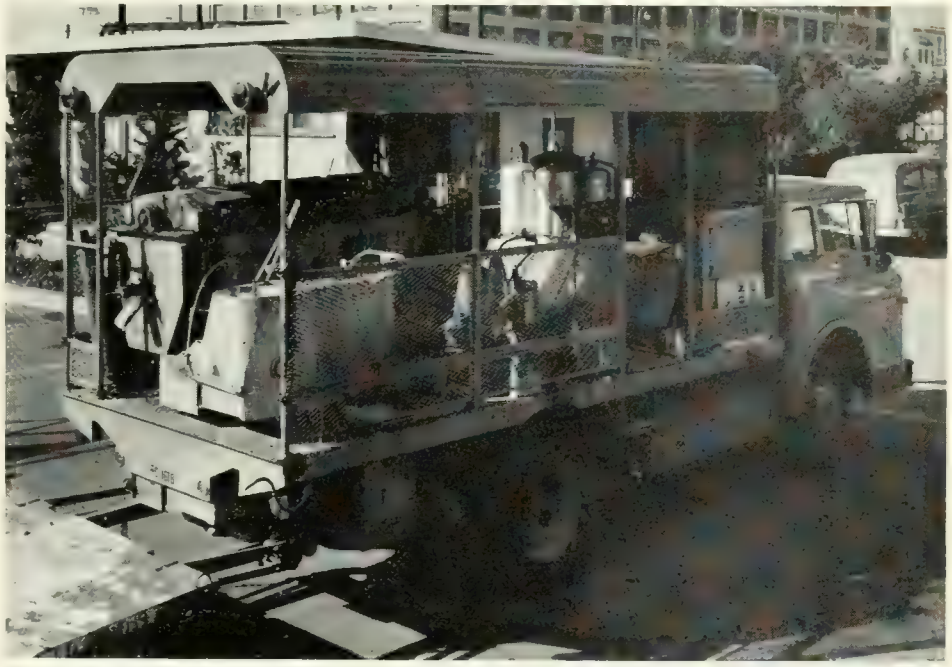
He is survived by a son, Curtis; a daughter, Mrs. Betty Thompson; two brothers; eight grandchildren and one great grandchild.

Traffic Stripes

New Thermoplastic Applicator Proves Worth in Heavy Use Areas

Certain traffic stripes and pedestrian crosswalk striping subject to heavy use in metropolitan areas require frequent replacement. In many of these critical areas, replacement can be made only under difficulty at times of least usage. The traffic lacquer used on the highways is good, and has long life, but for certain critical locations, something with better wearing qualities even though it costs more is more economical. For this reason, the use of hot melting, nonvolatile thermoplastic compounds developed for traffic marking was considered.

Recognizing the advantages of a thermoplastic-type stripe, Division of Highways Maintenance Department requested the Equipment Department to purchase and assemble on a 2½-ton truck, all of the components necessary for applying thermoplastic traffic striping. Two units were constructed for use on an experimental



The complete thermoplastic striping truck. Note the location of the hand applicator at the rear of the truck and the hydraulic tailgate which is used to load and unload the applicator.



The stripe applicator in operation. Note the base truck parked in the background out of the way of traffic.



Charging the applicator with hot thermoplastic compound that has been heated in the kettle.



Liquid petroleum in these fuel tanks is used for the thermoplastic heating operation.



Charging the kettle with solid thermoplastic material. Repeated heating of the material does not harm it.

basis in the Los Angeles and San Francisco metropolitan areas.

At Equipment Department Headquarters, two 2½-ton tilt-cab trucks were equipped to handle the thermoplastic striping. This required designing and building special truck bodies to carry a liquid petroleum fired kettle which would melt 800 pounds of the plastic material in one heating. To support this kettle, fuel tanks, heat exchange oil tanks, and a storage bin for the solid material were required. Special toolboxes and access steps to the truck were also required.

The thermoplastic applicator, which is hand operated, is carried from job to job on the truck. It is loaded and unloaded by means of a hydraulically operated tailgate, which also acts as a loading platform when the applicator is charged. The entire striping unit is self-contained, so that it may operate away from its headquarters without the necessity of frequent returns for service.

In operation the material is heated to approximately 600 degrees in the kettle, and then is poured into the hand-operated heated applicator from which the heated material is poured onto the pavement at temperatures between 400 and 450 degrees. The stripes can be poured in widths of 4 inches, 8 inches, and 12 inches. The depth of the stripe is approximately one-eighth of an inch. If beads are required, they may be mixed in with the heated material for exposure as the stripe wears, and a surface layer of beads may be dropped onto the stripe from a bead dispenser mounted on the applicator.

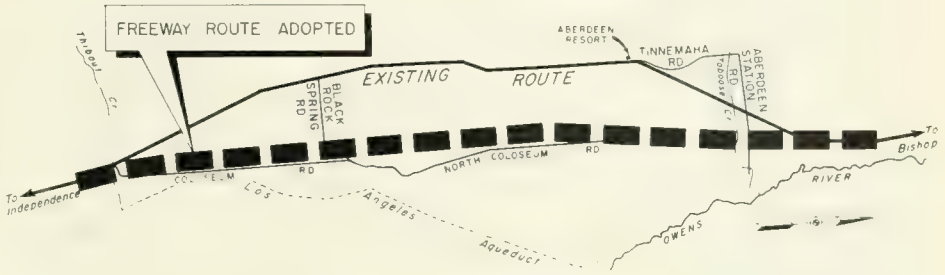
The material will harden sufficiently within eight minutes at an atmospheric temperature of 90 degrees to allow traffic over the lines without pickup or impression. At 50 degrees Fahrenheit the material requires five minutes to harden. The plastic will not break down or deteriorate when in its heated liquid form for long periods of time, and repeated heating does not harm it.

Material costs are much higher than traffic lacquer. Application is much slower than painting. However, the increased wearing ability and the elimination of repeated striping under adverse conditions compensate for the added cost of the thermoplastic stripes.

6,240 Miles

Route Adoptions Now Exceed Half of State Freeway System

The California Highway Commission has passed the halfway mark in the adoption of routes for the 12,414-mile California freeway and expressway system established by the 1959 Legislature. As of August 23, when the commission closed its August meeting, 6,240.5 miles of freeway routes had been adopted. The halfway point was actually reached in July when the commission adopted 10.1 miles of freeway routes to bring the total to 6,213.2 miles.



Interstate Standards

The freeway and expressway system includes nearly 2,200 miles of state highways on the national interstate system, which are being built to interstate standards. The system will also include a number of miles of "two-lane expressways" which will have access control for traffic safety and the preservation of the highway against random encroachment.

The freeway and expressway system eventually will link all cities of 5,000 or more population and will carry 59 percent of the total vehicle travel when completed. Completion is scheduled in 1980 at an estimated cost of 10½ billion dollars.

Hearings Are Waived

None of the commission's eight freeway route adoptions in July and August involved a public hearing by the commission itself. Such hearings were waived by the cities and counties involved.

Routings Listed

July and August freeway route adoptions:

Imperial County—Routing for 6.5 miles of U.S. Highway 80 about five miles west of Winterhaven. Route follows the existing highway.

Inyo County—Routing for the relocation of 10.9 miles of U.S. Highway 6-395 between five miles north of Independence and Black Rock, about 10.8 miles south of Big Pine. Route runs for the most part about a mile to the east of the existing highway and on a more direct line.

Adopted in 1956

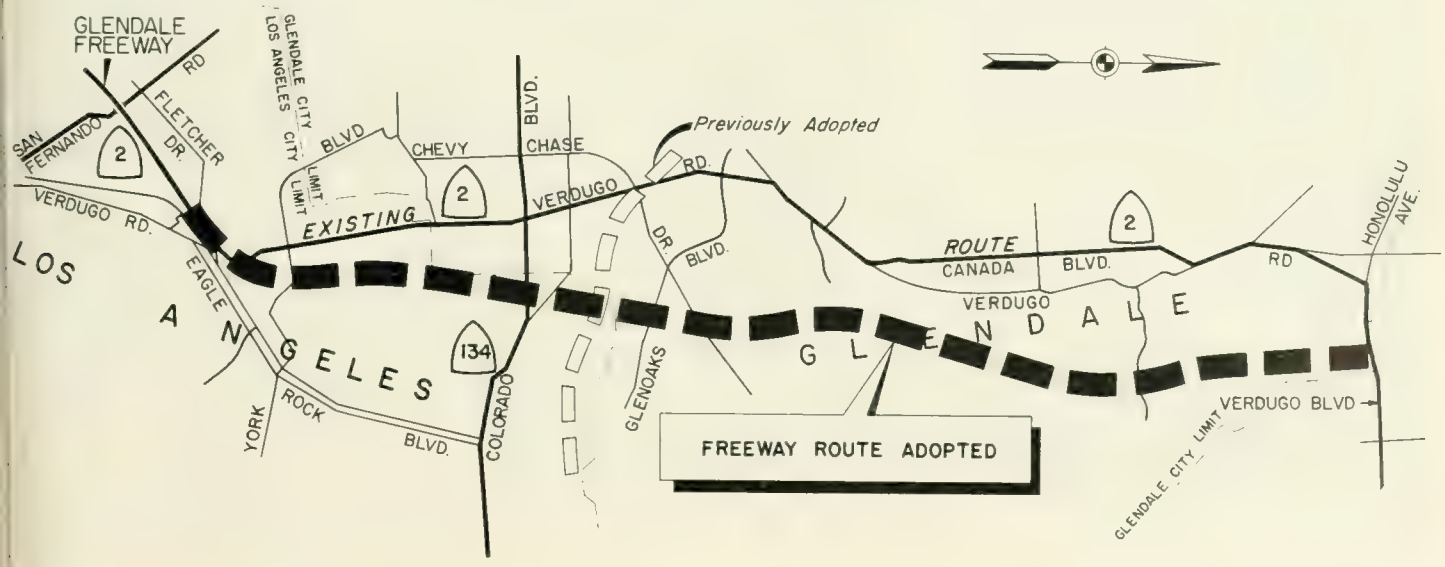
Kern County—Three miles of State Sign Route 178 (Walker Pass Highway) between three miles west of Weldon and Weldon designated as a freeway. Route itself adopted in 1956.

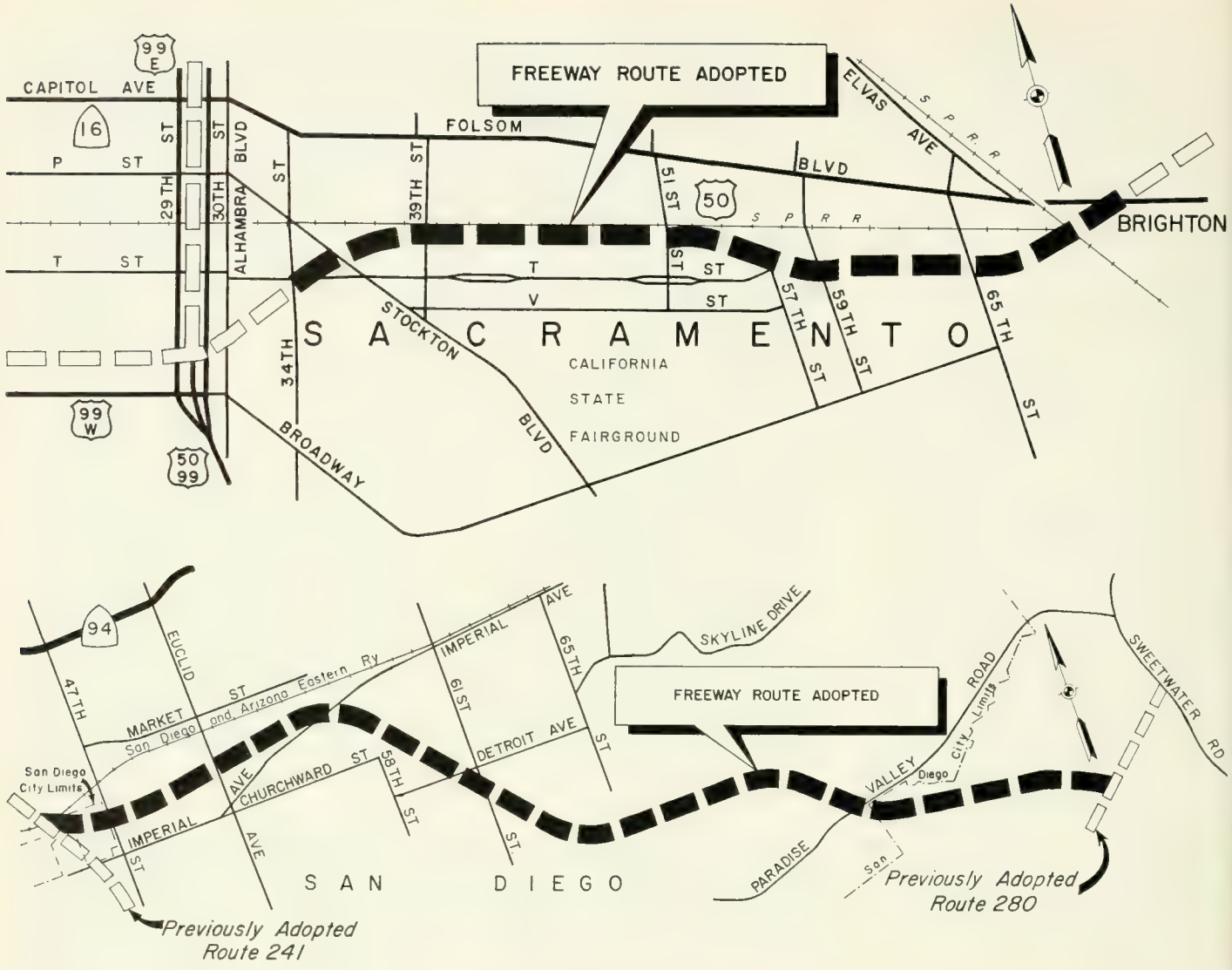
Los Angeles County—Routing for the Route 61 (Glendale) Freeway in Los Angeles and Glendale between Avenue 36 and Verdugo Boulevard, a distance of 6.3 miles. The route runs east of the existing highway, which is part of Sign Route 2.

Timber Trestle Replaced

Mendocino County—Routing for an access-controlled highway on State Sign Route 1 in the vicinity of De Haven Creek. Will eliminate a wide loop and allow for replacement of a timber trestle.

Modoc County—Routing for the realignment of two miles of U.S. Highway 395 in Modoc County between 0.7 mile north of the Lassen-Modoc County line and 0.1 mile north of County Road 63 near Likely. Route runs just to the west of the present highway and generally parallel to it.





Sacramento County—Routing for 2.7 miles of U.S. Highway 50 in Sacramento between 34th Street and Brighton. The route runs south of the present highway (Folsom Boulevard). It is adjacent to and parallel to the Southern Pacific Railroad tracks and close to the industrial development east of 57th Street.

Connects Future Freeways

San Diego County—Routing for 5.1 miles of State Highway Route 285 in the San Diego area between the adopted route for State Highway Route 241 (Interstate 805) and the adopted route for State Highway Route 280.

The planned Route 285 Freeway will serve as a major east-west connecting highway between the two other future freeways.

BRADFORD IS SPEAKER AT 30th ANNUAL A.B.T.T.A. MEET



Robert B. Bradford, Administrator of the California Highway Transportation Agency and Secretary of the California Toll Bridge Authority, was one of the principal speakers at the 30th annual meeting of the American Bridge, Tunnel and Turnpike Association, held in San Francisco from September 30 to October 4. Others shown are (left to right) H. G. Lohmiller, Secretary and Treasurer of the Davenport Bridge Commission, Davenport, Iowa; Norman C. Raab, Projects Engineer, Division of San Francisco Bay Toll Crossings; and John Pershing, General Manager of the Richmond-Petersburg Turnpike Authority of Richmond, Virginia, and president of the association.

Federal Aid — '51 to '62

By G. G. McGINNESS, Assistant Office Engineer

(This supplements the article by Assistant Office Engineer R. F. Reynolds, which appeared in the January–February 1950 issue of *California Highways and Public Works*.)

From the first apportionment in 1916 through June 30, 1951, California had received a total of over $281,000,000 of federal aid and other federal funds which aided in the financing of our highways and roads. Since June 30, 1951, the total has risen to over $1,700,000,000 including the apportionments for the 1961–62 fiscal year. The federal aid for the 1962–63 fiscal year amounts to more than the total for all the 35 years prior to July 1, 1951.

The national statement of policy concerning future federal-aid for highways, as adopted by the American Association of State Highway Officials on November 21, 1949, resulted in the enactment of federal-aid legislation that incorporated, for the most part, the association's recommendations.

Act of 1950

The Federal-aid Highway Act of 1950 provided federal-aid highway authorizations totaling $500 million for each of the fiscal years ending June 30, 1952, and June 30, 1953. While this act did not include an authorization for the Interstate Highway System nor were the authorizations for the other three classes of federal-aid roads as extensive as recommended by A.A.S.H.O., it did, however, provide for a $50 million annual increase over the sums authorized by the 1948 act.

Also the 1950 act embodied, with some modifications, the association's recommendations concerning the following: the use of federal funds for the retirement of bonds issued by a state for the construction of toll-free facilities; the withholding of federal funds from a city or county for failure to properly maintain a road which they have agreed to maintain instead of withholding from the state as a whole; the authorization of $5 million for disaster damaged highways on the federal aid systems on a 50–50 matching basis; and an increase in the federal ratio of participation in the cost of right-of-way from 33⅓ percent to 50 percent.

The 1950 act also included two new features of importance to the states. One was the requirement for the establishment of a secondary road unit in each state highway department desiring to utilize federal-aid secondary funds. The other new feature provided, as a condition of approval of any federal-aid project involving the bypassing of any city or town, that the state highway department certify to the Commissioner of Public Roads that it has had public hearings and considered the economic effects of such a highway location.

Both of these requirements had already been provided for in California.

Public Hearings

The policy of the California Highway Commission as adopted on July 15, 1948, provided for the holding of public hearings where proposed freeway improvements contemplate use of other than the traversable state highway. This policy was amended on July 23, 1953, and restated on February 18, 1955. The commission again revised its freeway route adoption procedure in 1958 "to provide additional guarantees that local views will be fully heard and carefully considered." (See *California Highways and Public Works*, March–April 1958.)

The 1950 federal act also increased the ratio of federal participation to 100 percent in the improvement of a federal-aid highway project within Indian reservations, nontaxable Indian lands,



PRIMARY—US 101, the Redwood Highway, in Marin County is on the Federal-Aid Primary System. This view is looking south across the Greenbrae Interchange and Corte Madera Creek.

and national parks and monuments under the jurisdiction of the Department of Interior.

First Interstate Funds

The Congress of the United States, recognizing the importance of early improvements to the national system of interstate highways, provided an initial authorization of $25 million a year for a two-year period, beginning July 1, 1953, in the enactment of the Federal-aid Highway Act of 1952.

The 1952 act also increased the yearly authorizations for the other three classes of federal-aid highways from a total of $500 million to $550 million for the 1954 and 1955 fiscal years.

Basis for Apportionment

The apportionment of interstate funds was made to the states on the same basis as provided by existing law for the apportionment of primary funds, i.e., on the basis of area, population, and post road mileage. The federal matching ratio for interstate funds remained the same 50–50 basis as authorized for the other three classes of federal-aid highway funds, i.e., primary, secondary and urban (also referred as "A," "B" and "C" funds, respectively, from the sections of the federal highway acts pertaining thereto).

Public demands for expediting highway construction were partly met by an added stimulus in the approval of the Federal-aid Highway Act of 1954 which provided a total authorization for each of the fiscal years ending June 30, 1956, and June 30, 1957, of $875 million. This yearly amount included $700,000,000 for the ABC systems and $175,000,000 for the interstate system.

California's apportionments under the 1954 act are shown in the accompanying table.

CALIFORNIA APPORTIONMENT UNDER 1954 ACT

System	*1955-56 F.Y.*	*1956-57 F.Y.*
Primary	$14,495,550	$14,521,798
Secondary	7,463,481	7,475,335
Urban	15,378,016	15,417,145
Interstate	9,770,990	9,792,836
Total	$47,108,037	$47,207,114

The total sums of $47,108,037 and $47,207,114 were added to the California State Highway Fund Budget for the 1955–56 and 1956–57 fiscal years, respectively, as estimated revenue in accordance with state law.

The sums of $6,530,546 and $6,540,919, which represent 87½ percent of the secondary apportionments, were reapportioned by the State to the counties for improving county road sections of the secondary or feeder road system in accordance with the California Secondary Highways Act of 1951.

New FAS Procedure

A radical departure from previous federal-aid legislation and procedure appeared in the Federal-aid Highway Act of 1954. This was the permissive acceptance by the Secretary of Commerce of a certified statement by the state highway department that an approved programmed secondary or feeder road project had been completed in accordance with the standards of design and procedures of construction adopted by that state and previously approved by the Secretary of Commerce. This certificate replaced the long-established procedure of plan, specification and estimate submission to and approval by the Bureau of Public Roads on each individual project.

Since one of the primary objectives of the federal-aid secondary highway program (that of aiding the counties in developing adequate highway engineering organizations) was well along toward complete accomplishment in California, there was no longer a need for close federal supervision. It, therefore, was only natural that California would be one of the first to sign an agreement under the plan. This became effective February 1, 1955.

The substitution of state for federal engineers in the field during the design and construction phase of the FAS projects has developed a closer association between the counties and the State resulting in a better understanding of mutual problems.

Apportioning Method Changed

The 1954 Federal-aid Highway Act also changed the method of apportioning interstate funds among the States. Instead of equal weight being given for the factors of area, population and mileage of post roads, the new interstate money was divided among the states in the following manner: one-half in the ratio which the population of each state bears to the total population of all the states, as shown by the latest available federal census, (with the guarantee that no state receives less than three-fourths of one percent of the money), and one-half in the manner provided for apportioning primary federal-aid funds. Thus the interstate apportionments were based two-thirds on population, one-sixth on area, and one-sixth on post road mileage. At that time California's share of the total apportionment was 6.19 percent.

The 1954 federal law also increased the ratio of federal participation in expenditures for interstate projects to 60 percent of the cost plus an increased percentage for the so-called "public lands states." Under the 1954 act, federal participation in California interstate projects was 66.75 percent.

The research powers of the Secretary of Commerce were considerably broadened by the provisions of the 1954 act so that the Bureau of Public Roads might engage in research on all phases of highway construction, maintenance, safety, financing and traffic conditions and have authority to test, develop, or assist in the testing and development of any material, invention, patented article or process. Such research work may be carried out in co-operation with any other branch of the government, state agency, authority, association, institution, corporation (profit or nonprofit), or any other organization, or person.

Authorizes Other Studies

The Secretary of Commerce was directed by the 1954 act to include in the authorized highway research program studies of economic highway geometrics, structures, and desirable weight and size standards for vehicles using the public highways and of the feasibility of uniformity in state regulations with respect to such standards and submit reports thereof of such studies to the Congress of the United States.

Another important feature of the 1954 act was the directive requiring the Secretary of Commerce to prepare a codification for action by Congress of all existing federal laws pertaining to federal-aid highway construction

and to supplement such a proposed codification act with recommended federal-aid highway legislation. The result was that the federal laws relating to highways were revised, codified, and re-enacted on August 27, 1958, as Title 23, United States Code, "Highways."

Financing Study

Perhaps the most important provision contained in the 1954 act is the one that required the Secretary of Commerce to make a complete study and submit a report to Congress not later than February 1, 1955, of all phases of highway financing, including a study of the cost of completing the several systems of highways in the states and of the progress and feasibility of toll roads with particular attention to the possible effects of such toll roads upon the federal-aid highway programs.

Preliminary estimates obtained from this report (entitled "Needs of the Highway Systems, 1955–84," House Document No. 120, submitted to Congress March 25, 1955) were used as a basis for President Eisenhower's 10-year national highway program.

The Federal-aid Highway Act of 1956 implemented the President's program by authorizing the appropriations shown in the accompanying table.

FEDERAL-AID HIGHWAY ACT APPROPRIATIONS

For fiscal year ending June 30	*ABC systems*	*Interstate system*
1957	$125,000,000	$1,000,000,000
1958	850,000,000	1,700,000,000
1959	875,000,000	2,000,000,000
1960		2,200,000,000
1961		2,200,000,000
1962		2,200,000,000
1963		2,200,000,000
1964		2,200,000,000
1965		2,200,000,000
1966		2,200,000,000
1967		2,200,000,000
1968		1,500,000,000
1969		1,025,000,000
Total		$24,825,000,000

The above authorizations for the 1957 fiscal year were in addition to those under the 1954 act resulting in a total apportionment to California for fiscal 1957 as follows:

Primary	$17,118,341
Secondary	8,806,491
Urban	18,211,275
Interstate	66,820,982
Total	$110,957,089



SECONDARY—This new bridge over the Tuolumne River on Stanislaus County Federal-Aid Secondary Road 914 (Geer-Albers Road) north of Turlock is one of the many recent projects financed by FAS, State and county funds.

The sums authorized by the 1956 act for fiscal 1957, 1958 and 1959 were apportioned on the same basis as those under the 1954 act. The apportionments for subsequent years were to be based on revised estimates of cost.

The federal share of cost of projects on the interstate system was increased by the 1956 act to 90 percent plus an increment based on the area of public land within the state which, at the time, made federal interstate participation in California 91.68 percent.

California's additional apportionments under the 1956 act are shown in the accompanying table.

CALIFORNIA'S ADDITIONAL APPORTIONMENTS UNDER 1956 ACT

System	*1957–58 fiscal year*	*1958–59 fiscal year*
Primary	$17,656,495	$18,821,209
Secondary	9,051,859	9,762,001
Urban	19,000,084	19,461,116
Interstate	96,947,850	115,365,437
Total	$142,656,288	$163,409,763

The Federal-aid Highway Act of 1956 provided for 41,000 miles of highways comprising the "national system of interstate and defense highways" to be fully completed in 1972, to standards adequate to accommodate the types and volumes of traffic forecast for the year 1975.

Estimates Required

The 1956 act provided that sums to be appropriated for the fiscal years 1960 through 1969 would be apportioned among the several states in the ratio which the estimated cost of completing the interstate system in each state bears to the sum of the estimated cost of completing the system in all of the states. It required such estimates to be submitted to the Congress by the Secretary of Commerce in January 1958, 1962, 1966, 1967 and 1968. When approved by Congress, these estimates were to be used in making apportionments for following fiscal years.

It also provided that apportionments would be available for expenditure for two years after the close of the fiscal year for which they were authorized and that funds covered by formal agreement for specific projects would be deemed expended. This same principle applies to ABC funds as well as interstate.

The act set definite weight and width limitation for vehicles using the inter-

state system. If state law permits these federal limitations or similar limitations effective under state law on July 1, 1956, whichever is greater, to be exceeded, no apportionment of interstate funds to the state can be made.

The interstate standards require construction of highways with the characteristics of freeways and with access fully controlled. The 1956 act prohibits the addition of points of access to or exits from an interstate project without prior approval of the Secretary of Commerce.

The act contains a section providing for predetermination of prevailing wages by the Secretary of Labor under the Davis–Bacon Act. In compliance with this section, the Secretary of Labor's wage decisions are included in the contract special provisions for every interstate project.

Hearings to Be Certified

The matter of public hearings was enlarged upon in the 1956 act. For a federal-aid highway project involving the bypassing of, or going through, any city, town or village, either incorporated or unincorporated, the State must certify that public hearings have been held, or an opportunity for hearings has been afforded, and that the economic effects of the location have been considered. If hearings are held, copies of the transcript of such hearings must be submitted to the bureau.

The 1958 resolution of the California Highway Commission, based on practices in effect prior to 1949, set forth the policy and procedure for compliance with the above hearing requirement.

Based upon a report of a study made by the Secretary of Commerce, in cooperation with the state highway departments and other interested parties, the 1956 act authorized the participation of federal funds in the cost of relocation of utility facilities necessitated by the construction of a federal-aid project.

Because federal apportionments are based on the estimated cost to complete the system, it is essential that federal fund participation be obtained in all improvement work in connection with the interstate highway system. As storm drains, storm sewers, flood control, drainage and reclamation works are not utilities, the relocation or reconstruction of such facilities must be handled as construction contracts. Often it appears expedient to have such work done by the owners rather than include it in a highway construction contract.

State Retains Responsibility

Although federal regulations permit a state highway department to have work done on a federal-aid project by a local public agency, the State retains full responsibility for all phases of such a project and the necessary procedures are prone to complications which make this manner of performance undesirable. All of the federal approvals needed for a project handled by the State, such as programs, plans, specifications and estimates, and concurrence in award of contract, are necessary when handled by a local public agency.

The labor compliance provisions including wage decisions by the Secretary of Labor, copies of contractor's payrolls, and reports are equally applicable to projects on the interstate system performed by a local agency.

Complications can arise if the agency uses other than the approved current standard specifications of the State. Also, certifications that the right of way is clear can be difficult to obtain from a third party.

Whenever possible, all work in connection with a project on the interstate highway system is handled as a regular state highway contract except when the work involves a utility facility.

The Highway Revenue Act of 1956 provided for a federal gasoline tax of 3 cents per gallon and revised other highway user taxes. A Highway Trust Fund was created into which the motor vehicle fuel and other highway user taxes are deposited. Despite expenditures from the trust fund the authorizations and apportionments, cannot exceed receipts (except in cases where advances may be made from the General Fund).

Act of 1958

The Federal-aid Highway Act of 1958 authorized $900,000,000 for fiscal 1960 and $925,000,000 for fiscal 1961 for the ABC systems under the regular formula for apportionment and ratio of participation. The authorization for the interstate system was increased to $2,500,000,000 for each of these fiscal years but the 1959 act cut the fiscal 1961 authorization back to $2,000,000,000. (At the same time the fiscal 1959 authorization was increased to $2,200,000,000 by the 1958 act.)

California's apportionment of these funds are shown in an accompanying table.

STATE'S APPORTIONMENT UNDER 1958 HIGHWAY ACT

System	*1959–60 F.Y.*	*1960–61 F.Y.*
Primary	$19,253,224	$17,451,261
Secondary	9,970,730	9,224,241
Urban	20,017,148	19,946,525
Interstate	252,779,750	181,086,840
Total	$320,020,852	$227,708,867

The above interstate apportionments reflected a new formula by which California received over 10 percent of the nationwide total, based on the needs to complete the interstate system as estimated in 1958.

Although the fiscal 1961 authorization for interstate was $2,000,000,000, the amounts estimated to be available from the trust fund were not considered sufficient to cover the expenditure of that sum so the above interstate apportionment is based on a national total of $1,800,000,000.

The ABC apportionments above for fiscal 1961 reflect the apportionments reduced by one-half of the money needed to pay back the borrowed "L" funds, which will be subsequently explained.

For the immediate acceleration of the rate of highway construction on the ABC systems, the 1958 act also authorized the additional amount of $400,000,000 for the fiscal year ending June 30, 1959. It also authorized an additional $200,000,000 for the interstate system for the same period.

California's apportionment of these additional funds was as follows:

System	*1958–59 fiscal year additional*
Primary	$8,647,217
Secondary	4,485,055
Urban	8,941,216
Interstate	11,594,516
Total	$33,668,004



URBAN—The heavily traveled Harbor Freeway in Los Angeles, running from top to bottom in this photo, is an example of a Federal-Aid highway on the Primary system within an urban area. The interchange at left center connects it with the Santa Monica Freeway, which is on the Interstate System.

The above ABC funds, known as "D" funds, were to be used for projects on which contracts could be awarded or work commenced prior to December 1, 1958, and completed before December 1, 1959. These funds were apportioned in the regular manner but the federal share of projects to be financed with this money was two-thirds plus the "public lands" additive.

To further accelerate the "D" fund program, the 1958 act authorized $115,000,000 as loans to the states which might have difficulty in providing matching money. These were known as "L" funds which were paid back one-half in fiscal 1961 and one-half in fiscal 1962.

California used "L" funds as follows:

System	*1958–59 fiscal year "L" funds*
Primary	$3,163,812
Secondary	1,074,665
Urban	1,050,650
Total	$5,289,037

As indicated earlier, the Federal-aid Highway Act of 1958 approved the January 7, 1958, estimate of cost of completing the interstate system as the basis for apportioning funds for the 1960 fiscal year and the 1959 act provided further that it be used for the 1961 and 1962 fiscal years.

The 1959 act increased the federal tax on gasoline to 4 cents from October 1, 1959, to January 1, 1961.

The Federal Highway Act of 1960 authorized $925,000,000 for the primary and secondary systems and urban extensions for the 1962 fiscal year and the same for the 1963 fiscal year.

California's apportionments for these years are shown on the accompanying table.

CALIFORNIA'S SHARE OF 1960 HIGHWAY ACT FUNDS

System	*1961–62 fiscal year*	*1962–63 fiscal year*
Primary	$19,664,114	$22,247,521
Secondary	9,303,650	10,532,114
Urban	24,525,621	25,004,182
Interstate	220,070,812	228,847,200
Total	$273,564,197	$286,631,017

The Federal-aid Highway Act of 1961 approved the apportionment of interstate funds for the fiscal years ending June 30, 1963, 1964, 1965, and 1966 on the basis of the estimate of cost of completing the interstate system as submitted to Congress on January 11, 1961.

California's apportionment factor for these years is 9.656 percent, based on $2,458,512,000 to complete the interstate system in California and $25,461,915,000 to complete the whole nationwide system.

It also amended the authorizations for the interstate system to the following:

Fiscal year ending June 30	*Authorization*
1957	$1,000,000,000
1958	1,700,000,000
1959	2,200,000,000
1960	2,500,000,000
1961	1,800,000,000
1962	2,200,000,000
1963	2,400,000,000
1964	2,600,000,000
1965	2,700,000,000
1966	2,800,000,000
1967	2,900,000,000
1968	3,000,000,000
1969	3,000,000,000
1970	3,000,000,000
1971	2,885,000,000
Total	$36,685,000,000

The 1961 act extended the four-cent federal gasoline tax indefinitely and increased various other highway user taxes which are deposited in the Highway Trust Fund.

Another important provision of the 1961 act was to permit the use of the airspace above and below the grade line of the highway pavement for purposes that will not impair the full use and safety of the highway.

As it was anticipated that revenue from taxes to be deposited in the Highway Trust Fund would not keep pace with the authorized spending, in October 1959 reimbursable obligation ceilings were established by the Bureau of Public Roads. California's ceiling for fiscal 1960 was set at $226,965,000. Within this period intermediate

ceilings were set which created cumulative ceilings as follows:

Actual Obligations	
July 1 to September 30, 1959	$21,427,000
October 31, 1959	35,363,000
December 31, 1959	62,603,000
March 31, 1960	144,784,000
June 30, 1960	226,965,000

On July 1, 1959, California had a balance of $138,121,654 of the 1959–60 and prior apportionments which was subject to these spending ceilings. As can be seen from the increments of $13,936,000 and $27,240,000 for the second and third periods respectively, the ceilings created a low rate of obligation in the first part of the fiscal year which prevented California from making full use of the apportionment and resulted in a slowdown in our rate of project advertising. By July 1, 1960, all but a few dollars of the funds available had been obligated. The sum of $58,896,000 was made available on July 1, 1960, and like amounts on August 2, 1960, October 10, 1960, and February 10, 1961, making a total of $235,584,000 released for the fiscal year ending June 30, 1961. By May 17, 1961, all but $35,671.32 of this available money was obligated.

On May 19, 1961, $72,189,000 was made available for obligation; the balance was $18,507,509.36 on August 21, 1961, when $72,195,000 was released. On December 1, 1961, and March 15, 1962, additional releases of $72,195,000 were made available making the total for the year $288,774,000. By June 30, 1962, practically all of this available money was obligated.

For the 1962–63 fiscal year, $420,893,000 has been scheduled for obligation. Of this amount $76,401,000 was released on June 14, 1962 and $98,302,000 on August 14, 1962. These two releases during the first quarter of fiscal 1963 together with the prior releases equal the total of the unobligated balance of the apportionments on July 1, 1959 and the subsequent apportionments for fiscal 1961, 62 and 63.

The accompanying table is a comparison of the apportioned funds and reimbursable obligation releases since the controls were made effective.

COMPARISON OF APPORTIONMENTS AND RELEASES

Fiscal year	*Apportionment*	*Releases*
Unobligated balance 6/30/59	$138,121,654	
1959–60		$226,965,000
1960–61	227,708,867	235,584,000
1961–62	273,564,197	288,774,000
1962–63	286,631,017	174,703,000 [1]
Subtotals	$926,025,732	$926,026,000
1962–63		246,190,000 [2]
1963–64	305,255,800	79,075,000 [3]
Totals	$1,231,281,535	$1,251,291,000

[1] First quarter 1962–63
[2] Scheduled for last three quarters 1962–63
[3] Estimated first quarter 1963-64

It is anticipated that the release for the first quarter of 1963–64 will be more than sufficient to bring the total releases in balance with the total apportionments.

Under reimbursement planning procedures, we may proceed with projects in excess of the reimbursable obligation ceiling by agreeing that federal reimbursement will not be made until funds are available for payment from the Trust Fund. These are called "E" projects. In July 1962 "E" projects in California totaled about $26,000,000. These have been converted and their value deducted from the current reimbursable obligation balance and reimbursement will be in accordance with an established schedule over a three-year period.

The Federal-aid Highway Act of 1961 authorized $2,600,000,000 for the interstate system for the fiscal year ending June 30, 1964, and $2,700,000 for fiscal 1965. In the 1962 act Congress authorized $950,000,000 for the primary and secondary systems and urban extensions for the 1964 fiscal year and $975,000,000 for 1965.

The federal-aid apportionments to California for the 1963–64 fiscal year will be substantially as follows:

(A) Primary System

The apportionment totaled $21,886,000. This is a little over 5 percent of $427,500,000, after provision to apportion not less than 0.5 percent to each state, which was authorized for appropriation to all states by Congress.

The apportionment of primary funds to the states is computed on the basis of one-third area, one-third population, and one-third post road mileage. The values of these elements at present are as follows:

In area, the United States has 3,618,659 square miles, California 158,693 square miles or 4.39 percent of the United States total.

In population (1960 census), the United States had 181,672,719, California 15,717,204 or 8.65 percent of the United States total.

In post roads, the United States has 2,665,294 miles, California 73,524 miles or 2.76 percent of the United States total.

(B) Secondary System

The apportionment totaled $10,178,000. This is over 3½ percent of the $285,000,000 authorized for all of the states.

The apportionment of secondary funds is based one-third on area, one-third on rural population, and one-third on post road mileage. The rural population element is as follows:

For the United States, 55,364,668; for California, 2,144,049 (3.87 percent of the United States total).

The other two elements are the same as for primary.

(C) Urban Extensions

The apportionment totaled $25,274,000. This is almost 11 percent of the $237,500,000 authorized for all states.

Urban funds are apportioned on the basis of population in places of 5,000 or more which in 1960 was as follows:

For the United States, 120,347,251; California, 13,173,572 (10.95 percent of the United States total).

(D) Interstate System

The apportionment totaled $247,917,800. This is 9.656 percent of the $2,600,000,000 authorized by the 1961 Federal-aid Highway Act for all states.

These funds were apportioned on the basis of the 1961 estimate of the cost to complete the system which is as follows:

For the United States, $25,461,915,000; for California, $2,458,512,000 (9.656 percent of the United States total).

Summary of Federal Aid to California for 1963–64 Fiscal Year

Primary	$21,886,000
Secondary	10,178,000
Urban	25,274,000
Interstate	247,917,800
Total	$305,255,800

This total is over 8½ percent of the $3,550,000,000 authorization for all of the states. For federal administration and reasearch, 1¼ percent was deducted before apportionment to the states and the above authorizations have been reduced by this percentage prior to figuring the estimates of apportionments.

The estimated federal-aid apportionments for the 1964–65 fiscal year are as follows assuming the same factors as used for the 1963–64 fiscal year:

Primary	$22,437,000
Secondary	10,421,000
Urban	26,348,000
Interstate	257,453,000
Total	$316,659,000

An entirely new phase has been added to the highway right-of-way acquisition program by a provision in the 1962 Federal-aid Highway Act which concerns relocation assistance to individuals, families and businesses displaced by acquisition or clearance of rights-of-way for any federal-aid highway.

Under this provision, the state highway department must give satisfactory assurance to the Secretary of Commerce that advisory assistance will be given to displaced families before authorization will be granted to call for bids on a federal-aid project.

Relocation Payments

The act also provides that the federal government will participate in relocation payments made by a state highway department to the extent of $200 in the case of an individual or family or $3,000 in the case of a business or nonprofit organization. A state is not required to make relocation payments unless authorized by state law.

Another provision of the 1962 act, which reaches into an area that has been given increasing consideration by highway engineers, concerns transportation planning in urban areas. Under this provision, programs for federal-aid projects in any urban area of more than 50,000 population will not be approved without a finding by the Secretary of Commerce that such projects are based on a continuing comprehensive transportation planning process carried on co-operatively by the state and the local community.

Of the funds apportioned for expenditure on the A, B, C, and interstate systems, since 1944 federal law has allowed 1½ percent to be spent for highway planning and research. As previously mentioned, the research activities of the Bureau of Public Roads were broadened by the 1954 Federal-aid Highway Act. As evidence of the increased emphasis on research in the highway field, the 1962 act makes the expenditure of the 1½ percent of the funds for planning and research mandatory. The act also provides that, in addition to the above, up to one-half of 1 percent of the A, B and C apportionments may be spent for highway research and planning upon request by the state.

The federal-aid secondary highway system, previously confined to rural areas, may now, under the 1962 act, be located both in rural and urban areas. This provision will alleviate a situation in California wherein counties often found themselves with deficient FAS roads in the urban fringe areas which were not eligible for FAS financing. Also, with more FAS projects reaching and some perhaps crossing city-county boundaries closer co-operation between these agencies may well be an additional benefit derived from the federal-aid program.

FEATHER RIVER BRIDGE

The new $9 million double-decked bridge over the west branch of the Feather River and a 13-mile section of U.S. 40 Alternate from Wicks Corner on the Oroville-Chico Road to Jarbo Gap in the Feather River Canyon has been opened to traffic. This construction is the first link of the $25 million rerouting of the Feather River Highway necessitated by the projected Oroville Dam project. Another highway link from two miles south of Oroville to the city limits will be completed this month. A third link is under construction.



INTERSTATE—Interstate 5 traverses California from south to north. This section of it is a part of US 101 in the San Clemente area, about midway between San Diego and Los Angeles.

San Diego-Coronado Bridge

In accordance with authorization given by the California Toll Bridge Authority at a meeting in San Diego on October 8, the Division of Highways has made a formal application to the United States Army Corps of Engineers to construct a toll bridge between San Diego and Coronado.

The proposed structure, to be built of steel and reinforced concrete, calls for four lanes of traffic with a 10-foot median dividing strip. Minimum vertical clearance would be 185 feet above mean high water through most of the width of the main 960-foot navigation span.

The location of the proposed bridge, as recommended by the Division of Highways in a 151-page report submitted to the CTBA summing up studies carried on under authority of the Budget Acts of 1961 and 1962, is between Crosby Street in San Diego and Fourth Street in Coronado.

A bridge at this location, costing an estimated total of $29,627,000, was recommended as being the most practical of nine alternate possibilities studied, seven of which were found to be financially feasible. Five of the alternatives involved two-lane tube construction; the other four involved four-lane bridges (four-lane tubes were found too costly to be considered).

It was brought out at the two-hour meeting and hearing of the CTBA that opposition to the bridge project is expected from the United States Navy; but the application for a permit is necessary in order to get a definite proposal on record on which the Corps of Engineers can make a finding-of-facts report.

The Corps of Engineers has responsibility under federal law for permitting installation of structures across navigable waters. In accordance with its regular procedure involving large structures, the corps is expected to call for public reaction in making its report.

Support for the proposal was expressed by numerous organizations in the San Diego area whose representatives appeared at the CTBA meeting, while opposition was expressed by the City Council of Coronado and some organizations in that city, and by employees of the ferry service now carrying vehicular traffic between the two cities.

Governor Edmund G. Brown, Chairman of the Toll Bridge Authority, emphasized that approval of the application for a permit did not mean that the authority had approved precise termini for the toll project, especially at the Coronado end.

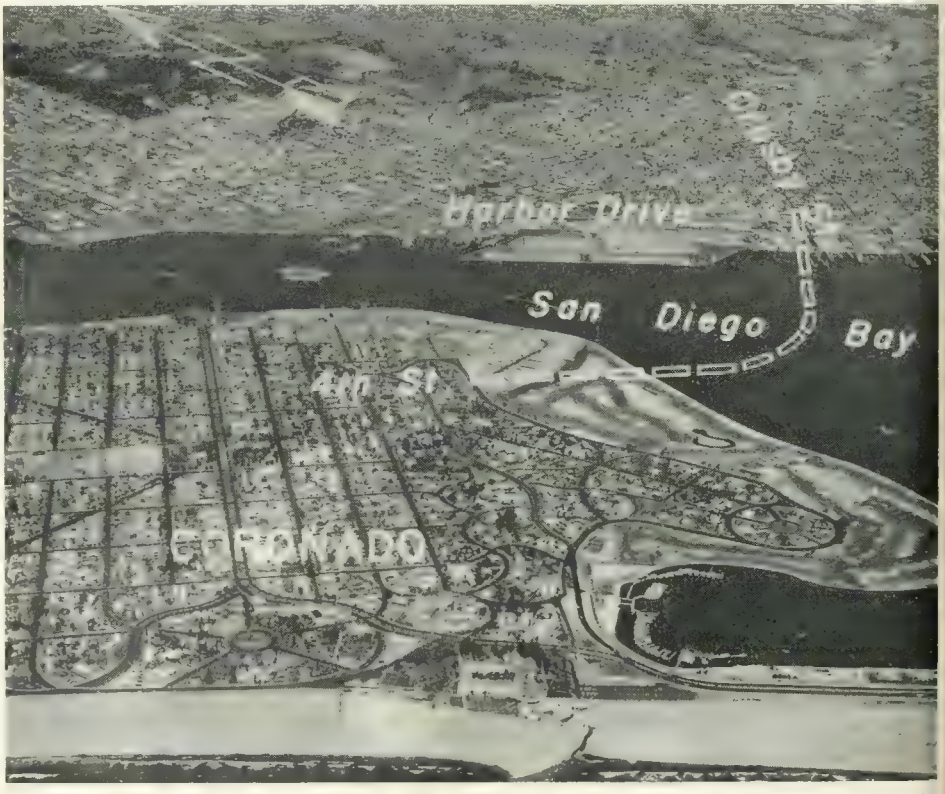


PHOTO ABOVE shows recommended bridge line "E" between Fourth Street in Coronado to Crosby Street in San Diego. The view is northeastward. PHOTO BELOW is of an architectural drawing showing the deck-type truss proposed for bridge spans in the 960-foot range.



District VII Loses M. F. 'Mique' Nelson

Myron F. "Mique" Nelson retired September 28 after 11 years as artist and delineator with the Division of Highways district office in Los Angeles.

His cartoons have appeared regularly in statewide C.S.E.A. publications. His is also well known for his birdseye drawings of freeway interchanges which aid the layman in visualizing the appearance of future freeway construction, a technique he developed during his freelance days in Oakland before he came to work for the division.

Born in Tulare, California, Nelson grew up in Oakland, where he became a freelance commercial artist.

He served with a Red Cross ambulance unit in France during World War I.

He was associated with Walt Disney Productions for 17 years, where he became art director.

Retiring because of ill health in 1948, Nelson went into freelance magazine writing. His stories and articles have appeared in Red Book, Argosy and Colliers. He joined the Division of Highways in 1951.

Nelson is married and has two grandchildren.

Funds Are Allocated To Cut Road Deaths

Governor Edmund G. Brown has announced that the California Highway Transportation Agency has been authorized to use $25,000 of the State's allotment of federal highway safety research funds to launch a year-long statewide advertising campaign designed to reduce California's growing highway death toll.

"The action by the United States Bureau of Public Roads in authorizing the expenditure of this money paves the way for the start of a project which offers a unique approach to highway safety," Governor Brown said. "To my knowledge, this kind of program, which combines advertising with research, has not been tried anywhere else in the nation."

The California Highway Patrol and the advertising firm of Cunningham and Walsh, representing the Advertising Association of the West, have been working together on the preliminary phases of the program for almost two years, Patrol Commissioner Bradford M. Crittenden said.

"These two mass communications media are contributing their air time and poster spaces to this program without charge."

NASH RETIRES; STAFF CHANGES ARE LISTED

Two promotions and a retirement have been announced by the California Division of Highways.

R. V. Potter, an assistant planning engineer, has been named to the post of systems research engineer, replacing A. M. Nash, who retired October 1.

J. Frank Jorgensen, assistant district engineer, planning, in District XI, San Diego, has been promoted to the position of construction engineer for the division in Sacramento. He succeeds Milton Harris, who had held the post since 1954 and was recently appointed assistant operations engineer. Harris died on September 24. (See page 61.)


A. M. NASH

Prior to his promotion Potter was liaison engineer for co-ordination of highway activities with the works of other governmental agencies. Except for service with the Army Corps of Engineers during World War II, in which he held the rank of captain and won six medals and two battle stars, Potter has been an employee of the Division of Highways since 1929. He is a native of New York City and attended the New Jersey College of Engineering and Rutgers University.

Jorgensen started work with the Division of Highways in San Francisco in 1930 between semesters at the University of California and took a full-time position in 1931. He was transferred to Sacramento headquarters in 1934 and went to San Diego in 1936 where he served as resident engineer on construction projects, including the Cabrillo Freeway.


R. V. POTTER

Jorgensen was district construction engineer in District XI from 1947 to 1950, when he was promoted to assistant district engineer, operations. In 1957, he was assigned to the position of assistant district engineer, planning, with overall charge of the planning activities for the more than 1,000 miles of state highways in District XI.

A. M. Nash, whose career of almost 43 years with the Division of Highways has included numerous important assignments in Sacramento headquarters and in various areas of the State and whose work brought him national recognition in the field of highway engineering, was named systems research engineer in 1961.

In the course of his 42 years with the Division of Highways, Nash has worked in four of the division's 11 districts, serving as district engineer in three of them (Eureka, Marysville, San Luis Obispo), in addition to three tours of duty in headquarters office in Sacramento. From 1946 to 1949, he was engineer of design for the division.

Nash is a native of Elk City, Kansas, was educated in Idaho and Washington, his college work having been at the University of Washington. During World War I, he served as a second lieutenant in the Army Aviation Service. He joined the Division of Highways in 1919 as a draftsman and computer.


J. F. JORGENSEN

He is a past vice president of the Western Association of State Highway Officials and has served on important national committees concerned with highway design and construction.

Folkins Is Champion Lawn Bowler of World

The Division of Highways has a world champion in its ranks. He is Dick Folkins, senior highway engineer in the programs and budgets department of District VII who was adjudged the outstanding lawn bowler of the world at a recent competition in Seattle.

To earn the title, Folkins led his team in seven games against competition from this country, Australia, New Zealand, England, South Africa, and Canada. His four-man team made a clean sweep of all seven victories in the international race and in addition copped the American Lawn Bowling Association's Rettie trophy in the triples, which ran six games. The competition was held July 1–10.



DICK FOLKINS

Folkins says the international competition was the stiffest he has ever entered and that the teams from the British Empire were among the strongest there. He has previously participated in a number of national tournaments and has nine other trophies to display from these victories.

Folkins bowls on the average of once a week at his own club, the Arroyo Seco, which consists of approximately 70 members. He himself has been playing for 37 years and says that the number of people interested in lawn bowling in Southern California is gradually increasing, although those interested in formal competition are becoming fewer.

The division boasted another champion several years ago in Tommy Kono, a drafting aid in the highway planning survey, who shattered many world weight-lifting marks as a member of the United States Olympic team at Helsinki in 1952 and subsequent international competitions. Kono has since left the division to go into private business.

Construction Expert Retires in Bay Area

Burnell Van Dalsem, Assistant District Construction Engineer, retired August 1 after more than 34 years with District IV of the California Division of Highways.

Born in San Rafael and educated in the public schools of Martinez and Santa Clara, Van Dalsem joined the Division of Highways in San Francisco in June 1928.



B. VAN DALSEM

Many years of his service with the Construction Department were spent with various Marin County projects including the Waldo approach to to the Golden Gate Bridge.

For the past 13 years he has been assigned to District IV headquarters as Assistant District Construction Engineer in charge of office engineering.

Van Dalsem is a member of Marin Lodge 191, F. & A. M., and from 1955 through 1961 he served as secretary-treasurer of the Division of Highways Quarter-century Club.

He and his wife, who now live in San Rafael, had one son, killed while serving with the U.S. Army in Germany in 1952.

Gillis, Spickelmire Write ARBA Bulletin

The American Road Builders' Association has published "And Now Slip Form Paving" as ARBA Technical Bulletin No. 250.

The 24-page ilustrated bulletin, written by L. R. Gillis, Assistant State Highway Engineer, and Leigh S. Spickelmire, Paving Engineer, both of the California Division of Highways, summarizes the experience with slip-form paving in California since the first experimental project in 1956. The bulletin also discusses various changes in portland cement paving methods used in California since the first portland cement concrete pavement was constructed on the state highway system in 1912.

Technical Bulletin No. 250 may be purchased from the American Road Builders' Association, World Center Building, Washington 6, D.C., for 50 cents per copy. Quantity discounts will be quoted on request for 25 or more copies.

Funds Allocated for Prehistoric Salvage

The California Highway Commission in August allocated $10,000 for salvaging prehistoric remains of archaeological importance that otherwise would be destroyed by freeway construction.

Seven sites believed to contain much information on the westward migration of the Yuman-speaking Indians were discovered by the University of California Archaeological Survey, Los Angeles, between Laguna Junction in San Diego County and Coyote Wells in Imperial County. They lie in the path of the proposed relocation of U.S. 80 as a freeway.

Large quantities of pottery and stone artifacts have been found on the surface at Cottonwood Creek, the most significant site, one mile south of Laguna Junction, and at several locations in Walker Canyon, east of Boulevard, and in Devil's Canyon, on the eastern border of the Jacumba Mountains in southwestern Imperial County. Their discovery offers promise that by careful excavation and analysis of the areas, the cultural sequence at the sites can be reconstructed, according to archaeologists.

The State Division of Beaches and Parks will act as the co-ordinating agency between the Division of Highways and the archaeological workers who will remove and pack objects of value.

The United States Bureau of Public Roads has declared it a matter of national policy to preserve or salvage ruins, sites, artifacts, fossils or other objects of antiquity. The project will be financed in part by federal funds, authorized for this purpose by the Federal-aid Highway and Revenue Act of 1956.

Milton Harris

Milton Harris, longtime highway engineer with the California Division of Highways, died on September 25, in Sacramento, after an extended illness. An employee of the division almost continuously since 1928, he had been assigned as construction engineer since 1954.



MILTON HARRIS

He had previously served as district engineer for District IX with headquarters in Bishop, and had held other assignments in District II (Redding), District IX and Sacramento. Prior to joining the division he graduated from Oregon State College and served as a first lieutenant in World War I.

When construction materials became scarce in the early days of World War II Harris was assigned the responsibility of working out the materials priority problems for necessary highway construction. He was recalled to military service with the Army Corps of Engineers in July of 1942.

Harris served in Italy as a lieutenant colonel with the Allied Military Government and was traffic engineer for the City of Rome. He was awarded the Cross of St. Maurice and Lazarus by the Italian government, and the Lateran Cross by the Vatican.

Upon his return to the Division of Highways in 1946 he was placed in charge of inspecting and purchasing war surplus materials for the Division of Highways in the Sacramento headquarters. Later, as service and supply engineer, he had full charge of and developed procedures for procurment, warehousing and distributing all materials and supplies used by the division. Early in 1953 he was promoted to district engineer at Bishop, and in December 1954 he returned to Division Headquarters as construction engineer. He was appointed assistant operations engineer in August 1962.

Harris is survived by his wife Sabina.

Department Announces Latest Retirements

District I

Harry A. Albright, groundsman, 7 years; Leland T. Crane, senior right-of-way agent, 17 years; Alton D. Cromwell, highway maintenance man II, 28 years; Floyd E. Davis, highway maintenance man II, 9 years; William V. Ferrill, highway foreman, 27 years; Richard H. Ramsey, supervising right-of-way agent, 26 years.

District II

George R. Barry, senior highway engineer, 31 years; Geoffrey Rogers, highway maintenance man I, 37 years; Henry E. Thorpe, highway foreman, 34 years.

District III

Loy W. Alston, highway foreman, 34 years; John J. McLaughlin, highway maintenance man II, 34 years; Daniel W. Pingree, highway foreman, 34 years; Adelaide Reilly, intermediate typist-clerk, 10 years.

District IV

Ray F. Adams, highway maintenance man II, 26 years; Edwin H. Boese, highway maintenance man III, 30 years; Joseph Casini, highway maintenance man I, 18 years; Alfred E. Cooper, highway superintendent, 26 years; Arthur M. Elton, highway maintenance man III, 29 years; Walter J. Flynn, storekeeper I, 16 years; Hugh G. Munro, highway foreman, 26 years; Burnell Van Dalsem, highway engineering associate, 34 years.

District V

Mark L. Cardwell, highway superintendent, 34 years; Jean M. Permasse, highway maintenance man II, 29 years.

District VI

Charles E. Powers, senior highway foreman, 11 years; Harry H. Sewell, highway foreman, 34 years.

District VII

Clifford F. Bartlett, electrician I, 11 years; James H. Clark, skilled laborer, 24 years; Joseph A. Kaiser, highway landscaping leadingman, 14 years; Alfred R. Mattos, highway maintenance man II, 28 years; Kenneth B. Pettis, highway field office assistant, 29 years; Cass M. Rose, senior highway engineer, 24 years.

District VIII

Loren D. Stanton, assistant highway engineer, 3 years; Chester H. Taylor, highway maintenance man I, 25 years; Leo P. Wagner, highway field office assistant, 28 years.

District IX

John H. Creed, senior highway engineer, 34 years; Herman Holt, highway superintendent, 31 years.

District X

Ewell W. Arnold, chief engineer, ferry system, 2 years; Ray A. Green, drawbridge operator, 13 years; George Soward, ferry operator, 10 years; Russell M. Stewart, deckhand, 1 year.

District XI

Maude E. Yauck, senior stenographer, 18 years.

Headquarters Office

Olive Armstrong, senior stenographer, 32 years; Nelson R. Bangert, supervising highway engineer, 34 years; E. Helen Halsted, assistant information officer, 36 years; Carolyn B. Vogt, intermediate stenographer, 10 years.

Headquarters Shop

Arthur O. Martinson, general superintendent of highway shops, 32 years; Emory E. Peck, senior machine parts storekeeper, 29 years; Albert C. Smith, heavy equipment mechanic, 26 years.

Shop 2

Wilbur B. Clemmons, machine parts storekeeper, 12 years.

Shop 5

William R. Ramsey, automobile mechanic, 25 years.

Shop 7

Albert A. Hilton, highway equipment superintendent II, 41 years.

Maintenance Expert N. R. Bangert Retires

After 34 years service with the Division of Highways, Nelson R. Bangert, supervising engineer in headquarters maintenance department retired July 31. He was appointed assistant maintenance engineer in 1933, and has had the same job ever since.

Bangert started his career with the Division of Highways as a draftsman in the District VIII office in San Bernardino in 1928, and shortly thereafter worked in the same district as an assistant resident engineer and as a highway maintenance foreman. In 1930, he became maintenance foreman at Barstow, and in 1931, an assistant resident engineer in Imperial County. In 1932, just prior to his headquarters assignment, he was maintenance superintendent at Indio.


N. R. BANGERT

Born in Alton, Illinois, Bangert came to California in 1907, attending school in Pomona, Los Angeles and Alhambra. He was graduated from the University of California in 1928 with a bachelor of science degree in civil engineering.

Bangert served as maintenance representative on the Division of Highways Bank Protection Committee from December 1953 to his retirement. One of the major accomplishments of this committee was publication in 1960 of a comprehensive reference book entitled *Bank and Shore Protection in California Highway Practice.*

When the United States Navy requested the consulting service of an asphalt paving engineer on the Island of Guam for two weeks in April 1946, Bangert was given this assignment because of his extensive experience in construction and maintenance of bituminous surfaces.

Other highlights of Bangert's career are his extensive work in the development and standardization of maintenance equipment and the programming of the orderly replacement and improvement of maintenance station facilities.

Bangert is an associate member of the Highway Research Board and of the American Society of Civil Engineers.

He and his wife Ethel make their home in Sacramento on Vallejo Way. They have two grown daughters, Dolores and Virginia.

Initial Funds for SSR 152 Relocation

The California Highway Commission in August voted an initial allocation of funds for a joint project with the Department of Water Resources for the relocating of 10.3 miles of the Pacheco Pass Highway (State Sign Route 152) on the north shore of the San Luis Reservoir, now under construction. The relocated section will extend from one mile west to 9.3 miles east of the Santa Clara–Merced county line and will ultimately cost in excess of $14 million.

State Highway Engineer J. C. Womack told the commission that the water project developers, the Department of Water Resources and the United States Bureau of Reclamation, will participate in the expense of the highway relocation.

As the reservoir's dam will be constructed across the existing two-lane highway by early 1965 and the project will require constructing 12.4 miles of four-lane expressway on a roadbed graded for six lanes through rugged terrain, it is imperative that highway relocation work begin as soon as practicable, Womack said.

The project includes building dual reinforced-concrete bridges, each 560 feet long, across the San Luis Forebay portion of the reservoir and providing for connections with roads to service local recreational areas that eventually will be developed in the vicinity.

The commission allocated $100,000 from the 1962–63 state highway budget as an initial contribution to the project at today's meeting. A total of state highway funds in excess of $5 million will be required as the Division of Highways share.

District II Engineer George Barry Leaves

George R. Barry, senior highway engineer in District II (Redding) retired on July 3, 1962. He had been with the Division of Highways for 30 years.

Barry began his state service as an assistant draftsman in Stockton in 1930. He worked for the United States Forest Service from 1933 to 1935 as location engineer on forest highways. He re-entered state service at Bishop in 1935 and then served successively in various engineering assignments with the bridge department, District III at Marysville, and District X at Stockton. In 1950 Barry transferred to the division headquarters in Sacramento, where he received his appointment as senior highway engineer. His primary duties at Sacramento were expediter and procurement officer for steel and copper products for the State during the Korean conflict.


GEORGE R. BARRY

In 1953 Barry transferred to District II in Redding, where he served as district construction engineer until his retirement.

Born in Enumclaw, Washington, Barry attended grade school in Enumclaw, high school at Kent, Washington, and graduated in 1930 from Polytechnic College in Oakland with a bachelor of science degree in civil engineering.

He is a member of the California Society of Professional Engineers, an Elk, and member of Dale Carnegie Club International.

67 PROJECTS ADVERTISED

During September the Department of Public Works advertised for bids on 67 highway projects with an estimated value of $58,785,900. Another 52 contracts for $11,034,200 were awarded and 55 contracts for $9,845,500 were completed. Bids were received from 218 contractors for 45 projects, an average of 4.8 bidders per project.

IN MEMORIAM

District I

Raymond Totten, highway maintenance man II

Harry Veach, associate right-of-way agent

District II

Elsie E. Atkins, intermediate typist-clerk

District III

Robert N. Smith, highway engineering associate

District IV

Manuel Variz, highway maintenance man II

District V

Louis J. Beuttler, highway maintenance man

District VI

Edgar R. Madewell, engineering aid II

Richard J. Manley, highway engineering technician I

James W. Follis, highway maintenance man II

District VII

Warren G. Klingler, highway maintenance man II

Ledell Edwards, groundsman

Edward S. Haynes, junior civil engineer

District IX

Ivadell M. Smith, highway field office assistant

Theodore H. Smith, assistant highway engineer

Headquarters Office

Hazel Charleston Shine, intermediate clerk

Melbourne H. West, principal highway engineer

Milton Harris, principal highway engineer

Bridge Department

Charles C. Blount, foundation driller

Stanley Madan, stock clerk

Larkin F. Payne, foundation driller

Right-of-way Agent Leland Crane Retires

Leland (Lee) T. Crane, assistant district right-of-way agent of district I, Division of Highways, Eureka, retired on August 1.

Lee began his career of state service with District I in 1945 as an assistant right-of-way agent after spending 20 years working for the County of Los Angeles in engineering and right-of-way work.



LELAND T. CRANE

Born in Deerfield, Michigan, Crane moved to Colorado at an early age and completed his high school education in South Denver. He attended the University of Colorado, where he studied engineering, and, during World War II, took additional engineering courses at the University of Southern California.

Lee moved to California in 1923 after serving in the Army during World War I. He first worked in California for the Southern California Bell Telephone Company, leaving in 1925 to work for Los Angeles County.

As assistant district right-of-way agent, crane has been in charge of various right-of-way functions, including negotiations, appraisals, and right-of-way operations.

He is an active member of the Elks Club, the American Right of Way Association, and the California State Employees' Association.

Crane and his wife Neoma plan to take an extended tour of the United States next spring.

The Cranes have two sons, Leland T. II, of Seattle, and Keith, of Weaverville.

BRIDGE RECORDS SET

Heavy traffic on Sunday, August 5, set a new daily traffic record on the Carquinez Bridge, when 65,828 vehicles cross the span. The following week, August 12, 66,377 vehicles were tallied. The previous high was 64,225 vehicles a day, set on June 17 of this year.

Twenty-five-year List

The following employees received 25-year awards during July and August:

District I

Gordon S. McIntosh

District II

Virgil B. Cade
William J. Lowes
John P. Williams

District VIII

Henry J. Marsh

District IX

Lawrence O. Ford

Headquarters Office

Dwight H. Alderson
Charles A. Rider

Bridge Department

Harry T. Carter

Materials and Research Department

Eleanor Z. Smith

I.T.T.E. Sets Annual Conference at UCLA

The 15th annual California Street and Highway Conference has been scheduled for January 24–26, 1963, at the University of California, at Los Angeles.

The conference is sponsored by the university's Institute of Transportation and Traffic Engineering. It brings together the representatives of state, city and county road and street departments for technical discussions and also features nationally prominent guest speakers.

The second link of the Newport Freeway, a 3.5-mile segment from Chapman Avenue in Tustin to the Santa Ana Freeway, was opened to traffic on September 4. The first leg was from the Riverside Freeway to Chapman Avenue. The freeway eventually will connect with the Coast Freeway near Costa Mesa, a distance of 17.7 miles. The cost of the project so far, including rights-of-way, has been $20,678,000.

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

HIGHWAY TRANSPORTATION AGENCY

ROBERT B. BRADFORD . . . Administrator

DEPARTMENT OF PUBLIC WORKS . . . ROBERT B. BRADFORD, Director

FRANK A. CHAMBERS . . . . Chief Deputy Director

RUSSELL J. COONEY . . Deputy Director (Management)
HARRY D. FREEMAN . . Deputy Director (Planning)

T. F. BAGSHAW . . . . . Assistant Director
JOHN H. STANFORD . . . . . Assistant Director

JUSTIN DuCRAY . Departmental Management Analyst
S. ALAN WHITE . . Departmental Personnel Officer

DIVISION OF HIGHWAYS

J. C. WOMACK . . . State Highway Engineer, Chief of Division

CHAS. E. WAITE . . . Deputy State Highway Engineer
J. P. MURPHY . . . Deputy State Highway Engineer
J. A. LEGARRA . . Deputy State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
GEO. LANGSNER . . Assistant State Highway Engineer
FRANK E. BAXTER . Assistant State Highway Engineer
J. C. BURRILL . . . . . Comptroller
C. G. BEER . . . . . Urban Planner
L. L. FUNK . . . . . Planning Engineer
F. N. HVEEM . . . Materials and Research Engineer
J. F. JORGENSEN . . . . . Construction Engineer
SCOTT H. LATHROP . Personnel and Public Information
C. T. LEDDEN . . City and County Projects Engineer
H. C. McCARTY . . . . . Office Engineer
E. J. L. PETERSON . . Program and Budget Engineer
R. V. POTTER . . . . Systems Research Engineer
F. M. REYNOLDS . . . . Planning Survey Engineer
EARL E. SORENSON . . . . . Equipment Engineer
E. L. TINNEY . . . . . Maintenance Engineer
W. L. WARREN . . . . . Engineer of Design
G. M. WEBB . . . . . Traffic Engineer
A. L. ELLIOTT . . . . Bridge Engineer—Planning
L. C. HOLLISTER . Bridge Engineer—Special Projects
I. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area

Right-of-Way

RUDOLF HESS . . . . . Chief Right-of-Way Agent
DEXTER D. MacBRIDE . . . . . Assistant Chief
RAY E. O'BIER . . . . . Assistant Chief
R. S. J. PIANEZZI . . . . . Assistant Chief
JACQUES T. ZEEMAN . . . . . Assistant Chief

District I, Eureka

SAM HELWER . . . . . District Engineer

District II, Redding

H. S. MILES . . . . . District Engineer

District III, Marysville

ALAN S. HART . . Assistant State Highway Engineer

District IV, San Francisco

J. P. SINCLAIR . . Assistant State Highway Engineer
L. A. WEYMOUTH . . . . . District Engineer
R. A. HAYLER . . . . . District Engineer
HAIG AYANIAN . . . . . District Engineer

District V, San Luis Obispo

E. R. FOLEY . . . . . District Engineer

District VI, Fresno

W. L. WELCH . . . . . District Engineer

District VII, Los Angeles

E. T. TELFORD . . . Metropolitan District Engineer
A. L. HIMELHOCH . . . . . District Engineer
GEORGE A. HILL . . . . . District Engineer
A. C. BIRNIE . . . . . District Engineer
A. W. HOY . . . . . District Engineer

District VIII, San Bernardino

C. V. KANE . . . . . District Engineer

District IX, Bishop

C. A. SHERVINGTON . . . . . District Engineer

District X, Stockton

JOHN G. MEYER . . . . . District Engineer

District XI, San Diego

JACOB DEKEMA . . Assistant State Highway Engineer

State-owned Toll Bridges

CHARLES L. SWEET . . . . . Bridge Engineer

CALIFORNIA HIGHWAY COMMISSION

ROBERT B. BRADFORD . Chairman and Director of Public Works
ARTHUR T. LUDDY . . Vice Chairman Sacramento
JAMES A. GUTHRIE . . San Bernardino
ROGER S. WOOLLEY . . . San Diego
JOHN ERRECA . . . . . Los Banos
ABRAHAM KOFMAN . . . San Jose
FRANKLIN S. PAYNE . . Los Angeles
JACK COOPER, Secretary . . . Sacramento

DIVISION OF CONTRACTS AND RIGHTS-OF-WAY (LEGAL)

ROBERT E. REED . . . . . Chief Counsel

GEORGE C. HADLEY . . . . . Assistant Chief
HOLLOWAY JONES . . . . . Assistant Chief
HARRY S. FENTON . . . . . Assistant Chief

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

NORMAN C. RAAB . . . . Chief of Division
BEN BALALA . . . . . Principal Bridge Engineer

DIVISION OF ARCHITECTURE

EARL W. HAMPTON . . . Acting State Architect, Chief of Division

EARL W. HAMPTON . . . . . Deputy Chief, Architecture and Engineering
HUBERT S. HUNTER . . . . . Deputy Chief, Administrative
ARTHUR F. DUDMAN . . . . . Assistant State Architect (North)
TOM MERET . . . . . Assistant State Architect (South)
CHARLES M. HERD . . . . . Chief Construction Engineer

DIVISION OF AERONAUTICS

CLYDE P. BARNETT . . . . . Director, Chief of Division

Printed by CALIFORNIA STATE PRINTING OFFICE 72600 10 62 51,000

Transportation Agency Exhibit Tours State

This year the Division of Highways, a part of the Department of Public Works, joined with the two other agencies of the State Transportation Agency—The Department of Motor Vehicles and The Highway Patrol—in an exhibit which was shown at the State Fair in Sacramento, at the Los Angeles County Fair at Pomona, and at the Fresno District Fair.

The exhibit, which explained the cooperation of the three agencies in providing better and safer highway travel, was well received at all three fairs, and at Sacramento won a blue ribbon in the transportation class.

In Sacramento a detailed scale model of the area of the planned Second-Third Street Freeway in that city was used, and in Pomona a section of the Cross Town Freeway in San Diego as an example of interstate route design. In Fresno a model of the Santa Monica-San Diego Freeway Interchange in Los Angeles was exhibited, as well as the Sacramento model.

The exhibit was designed to be quickly erected and dismantled. Taken down on Monday, September 10, in Sacramento, it was in position ready for viewing in Pomona on the following Thursday. Since the Fresno Fair directly followed the Los Angeles County Fair, the same quick transfer was necessary. Since the Fresno Fair, parts of the exhibit are being used in still other parts of the State to explain to the public the workings of the various parts of the State Transportation Agency.

The exhibit was continuously manned at all three fairs by highway patrol officers and examining officers of the Department of Motor Vehicles. Building and setting up was by Division of Highways personnel. Design was by Joseph Ralph of the Division of Highways Audio-Visual Section.



Metropolitan Highway Engineer Edward T. Telford of District VII, Los Angeles, looks over the Transportation Agency exhibit at the Los Angeles County Fair in company of Sallye Jo Howell, fair queen (center), and her two attendants.

William Tuthill, Division of Highways Bridge Department Architectural Design Section, does last minute touchup of model displayed in Transportation Agency exhibit at Sacramento State Fair.



California Highways and Public Works
DIVISION OF HIGHWAYS
P O Box 1499
SACRAMENTO, CALIFORNIA

RETURN POSTAGE GUARANTEED

SEATTLE PUBLIC LIBRARY
4TH & MADISON
SEATTLE 4, WASHINGTON

R56

BULK RATE
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152



TECHNOLOGY

CALIFORNIA Highways and Public Works

S. [illegible] Public Library
FEB 18 1963



VEMBER–DECEMBER 1962

NUAL REPORT ISSUE

Letters of Transmittal

December 4, 1962

EDMUND G. BROWN
Governor of California

My Dear Governor:

It is a pleasure to submit to you the 16th Annual Report of the Division of Highways, Department of Public Works. The report presents an overall view of the California highway program for the 1961-62 fiscal year, and gives a broad picture of the steady progress which is being made to improve motor vehicle transportation facilities for our rapidly growing population.

The end of 1962 finds California first among the states in many other respects as well as population.

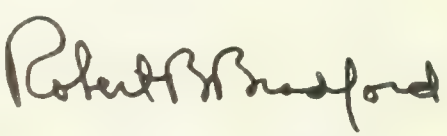
One of the principal areas of California's pre-eminence is in providing modern, toll-free multilane divided highways. We now have nearly 2,600 miles of these facilities in operation and an additional 350 miles under construction, most of the latter being of the full freeway type.

This leadership in modern highway construction is the result of long-time leadership in highway planning, crystallized in 1959 with the enactment of the 20-year freeway and expressway system master plan signed into law by you. More than half of the route location mileage for this 12,400-mile system, which includes California's 2,178-mile portion of the interstate system, has now been adopted by the California Highway Commission.

Effective planning is being continued and strengthened. State-local co-operation is being emphasized in freeway planning and design, including increasing attention to scenic and esthetic qualities as well as other community values. The relatively few locations involving some appreciable degree of controversy may make headlines, but the vast majority of the nearly 2,000 miles of routings adopted during the past four years have been worked out in harmony with local authorities. Many of these sections have involved complex location problems in urban areas.

This continuing highway progress is paying huge dividends in safety as well as mobility. It is reliably estimated that our present completed mileage of full freeways is saving over 300 lives a year in California, on the basis of comparison with accident statistics for the inadequate transportation arteries which the freeways have replaced. This saving of life and limb is one of our most significant accomplishments and, I know, the most gratifying to you personally.

Respectfully,



ROBERT B. BRADFORD
Director of Public Works

December 4, 1962

ROBERT B. BRADFORD
Director of Public Works
State of California

Dear Sir:

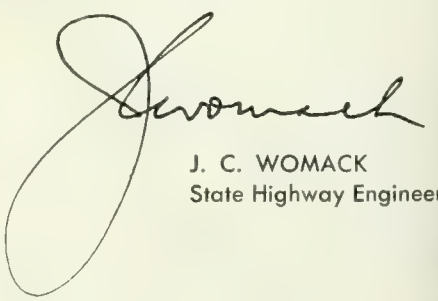
Submitted herewith for your approval and transmittal to Governor Edmund G. Brown is the 16th Annual Report of the Division of Highways.

This report is prepared in compliance with Section 143 of the Streets and Highways Code and generally covers the fiscal year ending June 30, 1962. Some later information on the construction program is included, as is the State Highway Budget for fiscal 1963-64 as adopted by the California Highway Commission on October 19, 1962.

The fruits of long-range planning and orderly construction on the state freeway and expressway system, including those routes included in the national system of interstate highways, are becoming increasingly evident. In 1962 more than 150 new miles of full freeway were opened to traffic, an increase of about one-third over the freeways opened in 1961. More than 50 miles of freeway were opened in the Los Angeles district alone, including the long-awaited downtown freeway loop. More than 350 additional miles of freeway are under construction.

At the same time construction is proceeding on other highway improvements throughout the State, as rapidly as available funds permit, in a continuing effort to attain a balanced program of meeting traffic needs.

Continuing the practice initiated in 1960, the text and illustrated portion of the annual report is again included in our bimonthly magazine, *California Highways and Public Works*. Financial statements, apportionment tables, contract statistics and miscellaneous other data will be published separately in a Statistical Supplement. This supplement is available to interested persons on request.



J. C. WOMACK
State Highway Engineer

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

Vol. 41 November-December 1962 Nos. 11-12



FRONT COVER—Part of the freeway through Redlands on U.S. 70-99 (Interstate 10) at the Cypress Avenue Undercrossing, completed in August 1962. The golden straw on the embankments provides erosion protection pending planting of trees, shrubs and periwinkles. The palm trees were transplanted to their present location (photo by Robert Dunn).

BACK COVER—Looking west along Carquinez Strait, with the new Benicia-Martinez Toll Bridge just west of the movable-span Southern Pacific railway bridge in foreground. City of Benicia at north end of bridge; Carquinez Bridge in far background (photo by Robert Rose).



CONTENTS

	Page
Departmental Organization Chart	2
California Highway Commission	3
California Highways—1962	5
Operations	21
Construction	21
Maintenance	23
Materials and Research	29
Equipment	34
Administration	37
Office Engineer	37
County and Co-operative Projects	40
City and Co-operative Projects	42
Service and Supply	43
Management Analysis	44
Systems Research	44
Planning	45
Advance Planning	45
Photogrammetric Mapping and Aerial Photography	46
Programs and Budgets	47
Design	48
Traffic	50
Highway Planning Survey	52
Bridges	54
Bridge Planning	54
Bridge Operations	55
Special Studies	58
Bridge Office Engineering	59
Special Projects	59
State-Owned Toll Bridges	60
Personnel and Public Information	62
Personnel	62
Training	63
Employee Safety	63
Audio-Visual	65
Public Information	65
Right-of-Way	67
Legal	69
Fiscal	71
1962-63 Budget	73

LESTER S. KORITZ, *Editor*

STEWART MITCHELL, *Associate Editor* JOHN C. ROBINSON, *Associate Editor*

WILLIAM R. CHANEY, *Chief Photographer*

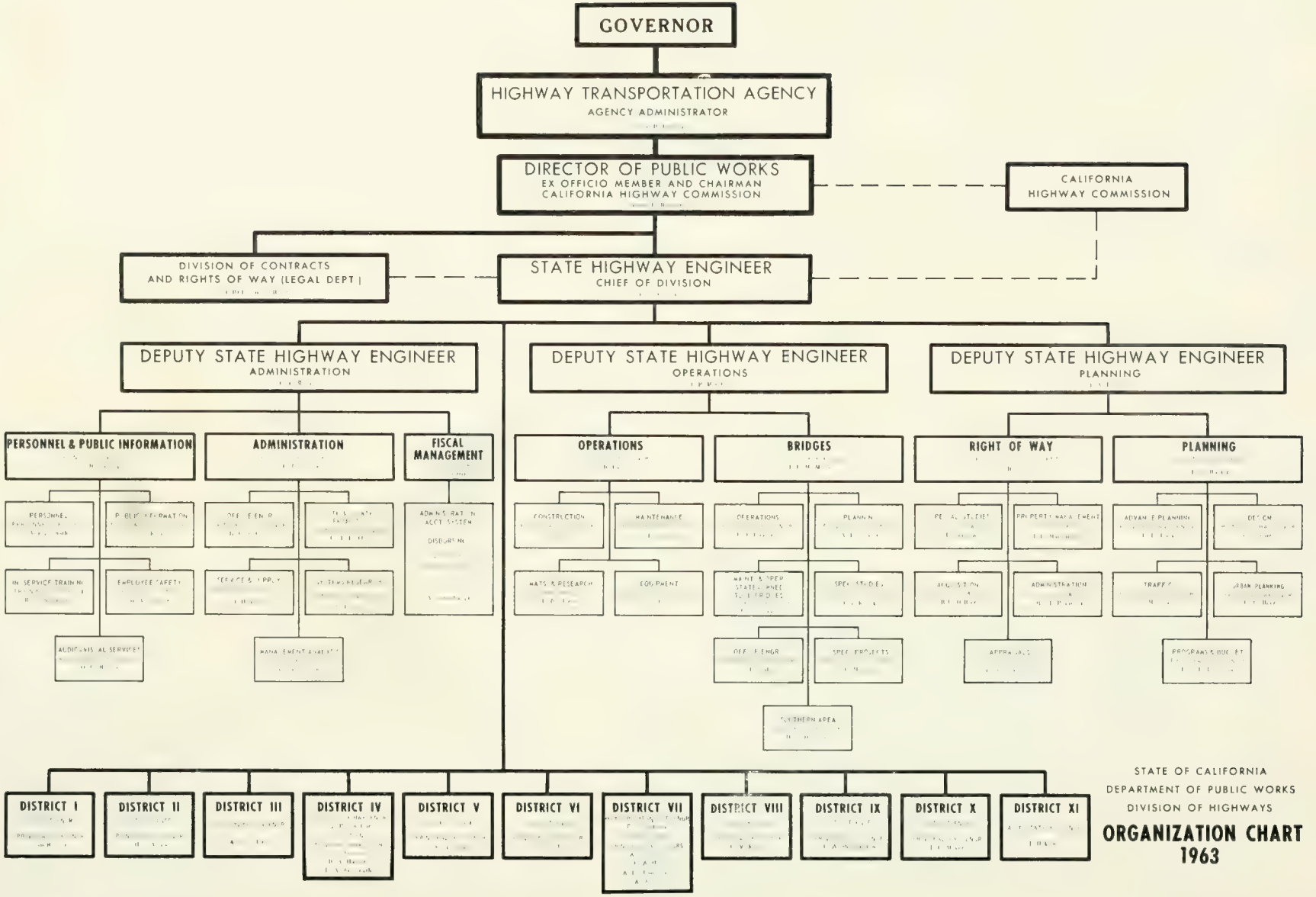
Editors are invited to use information contained herein and to request prints of any black and white photographs.

Address communications to: EDITOR,

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

P. O. Box 1499

SACRAMENTO, CALIFORNIA



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

ORGANIZATION CHART
1963

STATE OF CALIFORNIA—DEPARTMENT OF PUBLIC WORKS

CALIFORNIA HIGHWAY COMMISSION

ROBERT B. BRADFORD, Chairman, Ex Officio

Member	*Residence*	*Date of original Appointment*	*Term Expires*
JAMES A. GUTHRIE	San Bernardino	September 14, 1943	January 15, 1965
ARTHUR T. LUDDY	Sacramento	February 16, 1959	January 15, 1963
ROGER S. WOOLEY	San Diego	March 18, 1959	January 15, 1963
JOHN ERRECA	Los Banos	January 15, 1961	January 15, 1965
ABRAHAM KOFMAN	San Jose	September 14, 1961	January 15, 1964
FRANKLIN S. PAYNE	Los Angeles	February 3, 1962	January 15, 1966

Secretary: A. J. COOPER
Assistant Secretary: G. N. COOK (Retired February 1, 1962)
Assistant Secretary: ROBERT T. MARTIN

CALENDAR OF MEETINGS

CALIFORNIA HIGHWAY COMMISSION

July 1, 1961, to June 30, 1962

July 26, 1961 ..... Los Angeles
(Public hearing on freeway location, road VII-Ora-43-B, between 1.4 miles west of Route 176 and 2.3 miles east of Route 176.)

*July 26 and 27, 1961 ..... San Diego

*August 23, 1961 ..... Oakland

*August 24, 1961 ..... San Francisco

August 25, 1961 ..... San Francisco
(Public hearing on freeway location, road IV-S.F-253-SF, between Evans Avenue and Route 224 at Howard Street.)

September 15, 1961 ..... Monterey
(Special session for inspection of freeway route on road V-Mon-56-H, I-Mon,SndC,Sea, between Carmel River and Fort Ord. Met with officials from this area in a discussion of freeway development of above-mentioned section of State highway.)

*September 27 and 28, 1961 ..... Sacramento

September 29, 1961 ..... Mammoth
(Public hearing on freeway location, road IX-Mno-23-C,D, between Whisky Canyon and 1.8 miles north of McGee Creek.)

October 24, 1961 ..... Santa Monica
(Special session for inspection tour of freeways in the Los Angeles area.)

*October 25 and 26, 1961 ..... Santa Monica

October 31, 1961 ..... King City
(Public hearing on proposed relocation of road V-Mon-2-H,G,F,KnC,E, between 1.9 miles south of San Ardo and 1.6 miles north of King City.)

*November 15 and 16, 1961 ..... Sacramento

November 17, 1961 ..... Menlo Park
(Public hearing on freeway location, road IV-SM,SCl-107-MlP,B PA,A, between Santa Cruz Avenue and the Dumbarton Bridge.)

December 12, 1961 ..... Sonoma
(Public hearing on freeway location, road IV-Son-8,51-A, B;A,B,Son, between Sears Point, the Napa county line and Kenwood.)

*December 13, 1961 ..... Sacramento

December 14, 1961 ..... Sacramento
(Special public hearing with respect to the effect of the north-south freeway in the City of Sacramento on the historical sites involved, road III-Sac-238-Sac,C.)

January 24, 1962 ..... Sunnyvale
(Special session for inspection of highway projects in Santa Clara, San Mateo and San Francisco Counties.)

*January 25, 1962 ..... Sacramento

February 19, 1962 ..... Lakeport
(Public hearing on freeway location, road I-Lak-89-D, between 1 mile south of Kelseyville and the Junction of Route 16.)

*February 20 and 21, 1962 ..... Sacramento

March 27, 1962 ..... Los Angeles
(Public hearing on proposed relocation of road VII-LA-161-Pas, between Kensington Place and Lincoln Avenue, and road VII-LA-9-Pas,E,Ada, between Lincoln Avenue and 1,500 feet east of Michillinda Avenue.)

*March 28, 1962 ..... Los Angeles

March 30, 1962 ..... Los Angeles
(Special session for inspection of highway projects in the Los Angeles Metropolitan Area, and dedication ceremonies on the completion of the Los Angeles Freeway Loop.)

*April 25, 1962 ..... Sacramento

May 17, 1962 ..... Sacramento
(Public hearing on freeway location, road III-Sac-238-A, Sac, Legislative Route 238 (West Side Freeway) between 0.8 mile south of Freeport and 0.5 mile south of Broadway in the City of Sacramento.)

May 18, 1962 ..... Sonora
(Public hearing on proposed relocation of road X-Tuo-40, 65-A,B;B, between Yosemite Junction and Groveland, required by proposed construction of New Don Pedro Dam and Reservoir.)

May 22, 1962 ..... Los Angeles
(Special session for inspection of highway construction activities of San Diego as part of National Highway Week, and inspection of roads in Los Angeles, San Bernardino, and Riverside Counties.)

*May 23, 1962 ..... Los Angeles

*June 26, 1962 ..... Los Banos

* Regular meetings.

PAST MEMBERS OF THE CALIFORNIA HIGHWAY COMMISSION

Name	Residence	Date of appointment	Termination of membership
Burton A. Towne*	Lodi	Aug. 2, 1911	Resigned Jan. 14, 1914
Charles D. Blaney*	Saratoga	Aug. 2, 1911	Resigned Mar. 1, 1917
N. D. Darlington*	Los Angeles	Aug. 2, 1911	Resigned Jan. 8, 1923
Charles F. Stern	Eureka	Jan. 15, 1914	Resigned Dec. 21, 1918
Henry J. Widenmann*	Vallejo	Mar. 1, 1917	Died Oct. 6, 1918
Charles A. Whitmore*	Visalia	Nov. 29, 1918	Resigned Jan. 8, 1923
Emmett Phillips*	Sacramento	Dec. 21, 1918	Died June 18, 1919
George C. Mansfield*	Oroville	June 24, 1919	Resigned Jan. 9, 1923
Harvey M. Toy*	San Francisco	Jan. 9, 1923	Resigned Jan. 3, 1927
Louis Everding*	Arcata	Jan. 9, 1923	Resigned Jan. 17, 1927
Nelson T. Edwards*	Orange	Jan. 10, 1923	Resigned Jan. 3, 1927
Ralph W. Bull*	Eureka	Jan. 6, 1927	Resigned Jan. 6, 1931
J. P. Baumgartner*	Santa Ana	Jan. 6, 1927	Resigned Jan. 6, 1931
M. B. Harris*	Fresno	April 18, 1927	Resigned Jan. 6, 1931
Joseph N. Schenck*	Los Angeles	Aug. 19, 1927	Resigned Jan. 6, 1931
Fred S. Moody*	San Francisco	Aug. 19, 1927	Resigned Jan. 6, 1931
Earl Lee Kelly*	Redding	Jan. 6, 1931	Died Nov. 1, 1962
Frank A. Tetley*	Riverside	Jan. 6, 1931	Resigned July 31, 1935
Timothy A. Reardon*	San Francisco	Jan. 6, 1931	Resigned May 7, 1936
Harry A. Hopkins*	Taft	Jan. 6, 1931	Resigned Oct. 14, 1937
Philip A. Stanton*	Anaheim	Jan. 6, 1931	Resigned Mar. 3, 1939
Dr. W. W. Barham	Yreka	Dec. 20, 1932	Resigned May 21, 1935
Ray Ingels	Ukiah	May 21, 1935	Resigned Oct. 4, 1935
C. D. Hamilton*	Banning	Aug. 1, 1935	Died April 24, 1936
H. R. Judah*	Santa Cruz	May 7, 1936	Resigned Oct. 5, 1937
Paul G. Jasper*	Fortuna	May 7, 1936	Resigned Mar. 3, 1939
William T. Hart*	Carlsbad	July 7, 1936	Resigned Mar. 3, 1939
Robert S. Redington	Los Angeles	Oct. 5, 1937	Resigned Jan. 27, 1939
Frank W. Clark	Los Angeles	Jan. 27, 1939	Resigned Mar. 10, 1939
Lawrence Barrett	San Francisco	Mar. 3, 1939	Resigned Jan. 11, 1943
Iener W. Nielsen	Fresno	Mar. 3, 1939	Resigned Jan. 11, 1943
Amerigo Bozzani	Los Angeles	Mar. 3, 1939	Resigned Jan. 11, 1943
Bert L. Vaughn	Jacumba	Mar. 3, 1939	Resigned Jan. 11, 1943
L. G. Hitchcock	Santa Rosa	Mar. 10, 1939	Resigned Jan. 11, 1943
Gordon H. Garland†	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
Mrs. Dora Shaw Heffner†	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
Miss Helen MacGregor†	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
Verne Scoggins†	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
William Sweigert†	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
C. Arnholt Smith	San Diego	Sept. 14, 1943	Resigned Jan. 1, 1949
C. H. Purcell*	Sacramento	Sept. 14, 1943	Resigned July 31, 1951
Homer P. Brown*	Placerville	Sept. 14, 1943	Resigned Oct. 26, 1951
Harrison R. Baker	Pasadena	Sept. 14, 1943	Jan. 15, 1954
Charles T. Leigh	San Diego	May 11, 1949	Jan. 15, 1955
F. Walter Sandelin	Ukiah	Sept. 14, 1943	Jan. 15, 1956
Frank B. Durkee	Sacramento	Aug. 4, 1951	Resigned Dec. 31, 1957
H. Stephen Chase	San Francisco	Oct. 30, 1951	Resigned Feb. 25, 1958
Fred W. Speers	Escondido	Jan. 21, 1955	Jan. 15, 1959
C. M. Gilliss	Sacramento	Jan. 1, 1958	Resigned Nov. 10, 1958
John O. Bronson	Sacramento	Feb. 26, 1958	Jan. 15, 1959
T. Fred Bagshaw	Mill Valley	Nov. 10, 1958	Resigned Jan. 4, 1959
Robert L. Bishop	Santa Rosa	Jan. 15, 1956	Jan. 15, 1960
Chester H. Warlow	Fresno	Sept. 14, 1943	Jan. 15, 1961
John J. Purchio	Hayward	Jan. 15, 1960	Resigned Sept. 9, 1961
Robert E. McClure	Santa Monica	Jan. 18, 1954	Jan. 15, 1962

* Deceased.
† Member of the Interim Commission.

California Highways.....1962

As 1962 ends, California is the nation's most populous state.

Seventeen million Californians today operate nine million motor vehicles—1 out of every 15 in the world and 1 out of 9 in the United States—while driving 70 billion miles a year.

By 1980, the State's population and vehicle registration will nearly double and motorists and truckers will drive each year a staggering 200 billion miles.

But operating within the framework of a sound financing structure provided by the Legislature, and emphasizing controlled access highways with built-in permanence of traffic capacity, the Division of Highways and California Highway Commission are providing for high standards of traffic safety and mobility in 1980 for these huge fleets of vehicles.

The "California Freeway and Expressway System" enacted by the Legislature in 1959 provides a master plan for the construction of a 12,414-mile network of freeways and expressways by 1980 at a cost of $10,500,000,000. The system will connect all cities of 5,000 or more, and, though only 10 percent of the total road mileage, will carry an estimated 60 percent of all California traffic. It will serve every major industrial, agricultural, commercial and recreational region.

While progressing toward completion of this system, a "must" if the State is to continue to prosper, highway engineers are alleviating local deficiencies on non-access-controlled routes as funds permit. Roads are widened, resurfaced and realined to ease curves. Existing freeway sections are landscaped to improve esthetic values. Projects are budgeted to



The world's busiest highway, the Harbor Freeway in Los Angeles, passes under and connects with the new Santa Monica Freeway, a part of the downtown loop which was opened to traffic in March. The final link of the 22.6-mile Harbor Freeway extending it southerly to San Pedro was completed in October.

achieve a balanced construction program of benefit to each area of the State.

Progress Toward Goal

Contrasted with the 480 miles of multilane divided highways open to traffic in 1947 when vehicle registration was less than half 1962's total, as of the end of this year California had approximately 2,592 miles of multilane divided highway in operation. This comprised 1,180 miles of full freeways, 833 of expressways, and 579 of conventional (non - access - controlled) highways. Another 356 multilane divided miles were under construction, only 40 of which were not full freeways.

Since the Freeway Law was enacted in 1939, the Highway Commission has adopted nearly 6,300 miles of freeway routings, or more than half the 12,414 miles in the freeway and expressway system. The adopted routings include 2,000 miles of Californias' 2,178-mile share of the 41,000-mile National System of Interstate and Defense Highways.

The interstate system represents the largest construction project in the world's history. Its California mileage is financed about 91 percent by the federal government and 9 percent by state matching money. Each construction project must be approved by the U.S. Bureau of Public Roads to be eligible for federal funds.

A total of 473 miles of California Interstate System routes have been completed to standards adequate for present traffic, 286 miles of which are constructed to ultimate interstate freeway standards; 206 miles are under construction or advertised for bids, and 139 miles are included in budgeted projects.

The routing for the final link of the 316-mile Westside Freeway, an interstate route between Wheeler Ridge in southern Kern County and Woodland in Yolo County, was adopted last June.

Although several states show a greater mileage of interstate highways completed and opened to traffic, no state comes close to California in the amount of funds currently at work on interstate projects. This is due to California's putting considerable emphasis on the high-cost, short-mileage sections of multilane urban freeways to provide maximum traffic relief.

Long-range Planning

Much of the highway mileage on the freeway-expressway system, including the interstate, has been or is being constructed in stages.

Although legally expressways are classified as freeways, since access to them is controlled, they differ from full freeways in that some crossings at grade and left turn movements are permitted.

A freeway is appropriately named. It is free of traffic lights and stop signs, free of crossing traffic, and free of vehicles moving at random onto the highway from the sides of the road. It obtains these freedoms by limiting access to certain strategic points where traffic can enter or leave it safely, by not permitting left-turn movements across oncoming traffic, and by having intersecting streets, highways and railroads carried over or under it.

Both freeways and expressways are free from encroachment by roadside strip development that in time chokes conventional highways. Their carrying capacity and safety benefits are permanent. Both are also divided by median strips of varying widths.

Though both have a minimum of four lanes, some two-lane expressways are constructed, usually in rural or mountain areas with light traffic volume at present; but access is controlled and enough right-of-way is obtained





The patterns traced by vehicle headlights show turning movements onto the conventional highway from roadside businesses, adding further hazards for motorists already contending with spotting traffic signs and signals amid a blaze of neon. Through southbound traffic on U.S. 99 in Bakersfield (photo at left) has been using a portion of the freeway bypass of the city (right photo) since August. Northbound traffic lanes will be opened next fall when the entire bypass is completed.

to permit their future upgrading to four-lane expressway when traffic volumes warrant. By the end of 1962, California had 547 miles of two-lane expressways in operation.

Similarly, four- and six-lane freeways and even conventional highways frequently are built inside rights-of-way adequate for future additional lanes.

User Benefits

Of all the benefits that motorists obtain from freeways, the most important is safety. For the past several years, the fatality rate on freeways has been approximately one-third that of conventional rural highways, and the overall accident rate one-half.

Traffic engineers estimate that California's 1,180 miles of full freeway saved over 300 lives in 1962 and prevented more than 20,000 injuries and over 40,000 accidents. That is, if this freeway traffic had been carried on conventional highways, these figures would have been added to the statewide traffic toll.

Another safety feature of freeways is that access is barred to bicycles and pedestrians, and fencing keeps children from crossing them except at overcrossings and undercrossings.

Traffic safety on freeways and other highways is being promoted by a multipronged attack on the State's traffic death toll by the Highway Transportation Agency. A $100,000 appropriation by the 1961 Legislature is being used on research projects ranging from wrong-way freeway driving to analysis of the negligent driver.

The Division of Highways, Highway Patrol, Department of Motor Vehicles, University of California's Institute of Transportation and Traffic Engineering and the National Safety Council took part in working out study areas and priorities.

Not only do freeways save lives, they also save in fuel costs and wear and tear on equipment—more than one-half cent a mile when contrasted with city streets—by eliminating stops and starts at intersections. They also save driving time.

The Engineering Department of the Automobile Club of Southern California conducted a peak-hour travel time study last May in Metropolitan Los Angeles. Its employees recorded their time spent in commuting to all parts of the area on freeways, highways and city streets.

Travel speeds were found to average 30.5 miles per hour in 1962, compared with 26 miles per hour in 1960 and 24 in 1957.

The auto club ascribed this greater mobility to the completion of important segments of the freeway system which have relieved traffic on older routes by providing alternates.

Important as saved time is to the individual motorist, it is of even greater consequence in commercial operations where drivers' wages and maximum utilization of vehicles are major cost factors.

Community Benefits

Rather than dividing the community through which it passes, a freeway, by providing unhindered traffic flow on roads over and under it, unifies an area previously divided by congested through traffic.

Local purchasers, always the mainstay of a community's economy, find it convenient to drive and park downtown when heavy and nonproductive through traffic is diverted to the freeway route. Residents discover that much of the traffic noise and gasoline fumes that had annoyed them had been caused by the former frequent stops and starts at intersections.

The Right of Way Research and Development Section of the Division of Highways investigates land sales and changes in gross retail volumes, among other methods, to determine the effects freeways have on community development.

Its studies show that very little difference exists between the sale prices of homes adjacent to modern landscaped freeways and comparable ones a few blocks away. In many instances, they have increased.

Owners displaced by freeway construction usually remain in the immediate area. Since they have received



The Thousandth Mile



When the U.S. 101 freeway at Fortuna in Humboldt County was opened to traffic in July, California acquired its 1,000th mile of highway completed to full freeway standards. By year's end, this total had increased to 1,180 miles.

cash payments for their property, they more often than not acquire new properties more valuable than the ones they left, with resultant benefits to themselves and to the community.

By reducing transportation costs and time-distance factors, freeways make a community more attractive to industries seeking to relocate; a community's working force gains greater areas in which it can offer its skills, and local merchants record increased sales by downtown sites becoming more attractive to shoppers.

The Highway Organization

Credit for the acknowledged preeminence of the California highway program is clearly attributable to successive Legislatures, which have enacted sound laws over the years.

The Legislature has determined that the highway construction program should be financed on a pay-as-you-go basis by taxes on the highway user, and has delegated to the California Highway Commission the responsibility for allocating such user taxes to highway projects.

It further has charged the Highway Commission with determining specific routings between termini which it, the Legislature, designates.

California Highway Commission

Appointed by the Governor and confirmed by the State Senate, six members of the Highway Commission are business and professional men who serve without pay for four-year staggered terms. They represent the State as a whole rather than particular cities or areas.

The seventh member is the State Director of Public Works, ex officio chairman.

Commission duties include approving county primary road systems and authorizing condemnation proceedings, the execution of deeds and right-of-way relinquishments and abandonments, as well as budgeting highway funds and adopting freeway and highway routes.

Division of Highways

The actual day-to-day operation of the highway program, including planning, design, right-of-way acquisition, construction and maintenance, is vested in the State Division of Highways, a unit of the Department of Public Works.

It is headed by the State Highway Engineer, assisted by a headquarters staff in Sacramento, and by engineers in charge of each of the State's 11 highway districts (map shown on page 7), who are responsible for all phases of the highway program in their regions.

This decentralization assures that the highway construction and improvement program is responsive to local conditions and needs.

All employees of the division are career civil servants chosen on the basis of competitive civil service examinations.

Inquiries on local highway matters should be addressed as follows:

District I —Sam Helwer, District Engineer, 430 West Wabash Avenue, Eureka

District II —H. S. Miles, District Engineer, 1657 Riverside Drive, Redding

District III —Alan S. Hart, Assistant State Highway Engineer, 703 B Street, Marysville

District IV —J. P. Sinclair, Assistant State Highway Engineer, 150 Oak Street, San Francisco

District V —E. R. Foley, District Engineer, 50 Higuera Street, San Luis Obispo

District VI —W. L. Welch, District Engineer, 1352 West Olive Avenue, Fresno

District VII —E. T. Telford, Metropolitan District Engineer, 120 South Spring Street, Los Angeles

District VIII—C. V. Kane, District Engineer, 247 Third Street, San Bernardino

District IX —C. A. Shervington, District Engineer, South Main Street, Bishop

District X —J. G. Meyer, District Engineer, 1976 East Charter Way, Stockton

District XI —J. Dekema, Assistant State Highway Engineer, 4075 Taylor Street, San Diego

Highway Financing

Sound programing depends upon sound financing.

With a known number of registered vehicles, it is fairly easy to predict revenues from taxable gasoline and diesel fuel consumption, drivers' licensing and registration fees, weight fees on commercial vehicles, and taxes on for-hire trucking.

The State Constitution requires that all such highway-user source funds be spent for road construction and maintenance and for the administration of the Division of Highways, Department of Motor Vehicles and Highway Patrol. They may not be diverted for other purposes.

The largest source of funds is the six-cents-per-gallon state gasoline tax. Four cents per gallon are spent on construction and maintenance of state highways, 1⅜ cents on county roads and ⅝ cent on city streets.

The cities' share is distributed by the Division of Highways on a population basis, and the counties' share is distributed directly to the counties by the State Controller.

Approximately one-third of these street, road and highway funds represents moneys returned to the State from taxes imposed on the highway user by the federal government. This money is spent on the interstate routes (matched 9 percent by state funds) and on the federal-aid primary, secondary and urban highways (matched 2 percent by the State from user taxes).

State law requires that 55 percent of available construction funds be allocated each year to the 13 southern counties, and 45 percent to the remaining 45 counties; and that each county be guaranteed certain minimum amounts in a specified period according to a statutory formula based on relative state highway needs.

Expressway Into Freeway



Throughout the State, expressways are being converted to full freeway standards as traffic conditions warrant and funds become available. In the photo above, a section of U.S. 40 (Interstate 80) near Vacaville is being widened and cross traffic at grade eliminated by the construction of overpasses.

The State Highway Commission adopts an annual budget for the coming fiscal year each October or November. The 1961-62 budget contained an overall total of $633,460,000, of which $509,078,000 was for construction and right-of-way acquisition. Corresponding totals for 1962-63 and for the new budget adopted in October for 1963-64 were $658,370,017—$527,792,917, and $695,927,042—$554,677,084, respectively.

(A chart illustrating sources of state highway funds and the manner in which they are disbursed in shown in this section.)

Freeway Route Selection

As mentioned previously, the Legislature designates the termini of all state highways, whether conventional or freeway type, sometimes specifying certain control points.

Selection of specific routing is a responsibility of the Highway Commission. Governing bodies of cities and counties are notified at the initiation of studies leading to freeway construction. Co-operation and information on the area's master plan for transportation and development are requested.

Traffic origin and destination studies are correlated with such considerations as community plans for land use, engineering controls imposed by rivers and terrain barriers, economic and social controls including relative costs of right-of-way acquisition, and the

desire to avoid damage to schools, churches, parks and hospitals.

Consultations are frequent with utility and transportation companies, water districts, and interested agencies of federal, state and local government.

When the feasible routes are mapped and user benefits, cost factors and other considerations for each analyzed, public hearings are held by the district highway engineer to explain the studies to local residents and to obtain their views.

The district engineer sends his completed report and hearing transcripts to the State Highway Engineer in Sacramento, who, in turn, submits a recommendation to the Highway Commission.

The commission asks the local governmental bodies if they desire a public hearing before action is taken to adopt a route. Such a request is always granted. Occasionally, the commissioners may decide without a request that the public interest requires an additional hearing.

Finally, the commission weighs the traffic service benefits, construction costs and other features of each feasible alternative and adopts the routing which appears to serve the greatest public interest.

Throughout the route selection process, every effort is made to insure that the views and rights of all—property owners, local merchants, civic planners, and users of the new route, among others—are considered and protected.

The Division of Highways staff confers further with local officials and negotiates a freeway agreement with the city council or board of supervisors involved covering local street adjustments. Local agencies thus have a voice in such design factors as types and locations of interchanges and traffic separation structures.

When this agreement has been obtained, the Division of Highways can proceed with right-of-way acquisition and construction as funds become available.

Right-of-way Acquisition

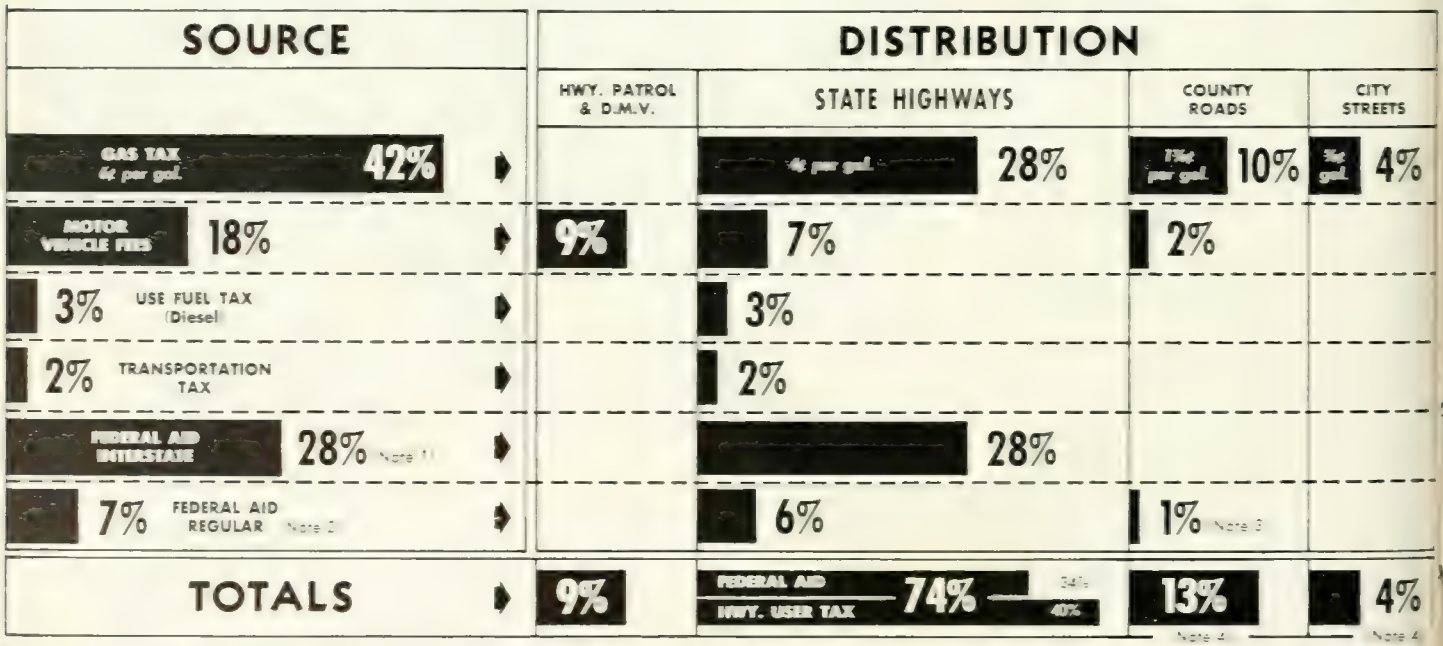
The Right of Way Department completed 9,081 parcel acquisitions for highway purposes in fiscal 1961-62 at a cost of $151,497,226. Over 97 percent of these transactions were arrived at by negotiation with the property owner. Only 2.7 percent of the transactions were concluded after eminent domain court proceedings.

After appraisal, the property owner is offered fair market value for his holdings as needed. This has been defined as "the highest price estimated

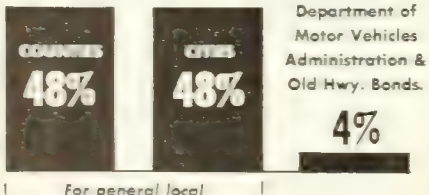
Highway User Taxes Including Federal Aid

Percentages based generally on 1963-64 Budget.

State of California
Department of Public Works
Division of Highways



IN LIEU PROPERTY TAX
ON VALUE OF MOTOR VEHICLES
collected by State



NOTES:

1. *Federal Aid Interstate must be matched 9% by State funds from above sources.*
2. *Federal Aid Primary, Secondary, and Urban must be matched 42%, mostly by State funds from above sources.*
3. *Does not include matching funds, up to $100,000 per county per year, from State Highway Fund.*
4. *Does not include $5,000,000 per year State highway matching funds for local railroad grade separations, or about $1,500,000 a year for urban extensions of F.A.S. county roads.*

Division of Highways personnel confer with interested governmental, civic and business representatives during all stages of freeway planning. At right, William Mahan of the Sacramento historical Landmarks Commission points out an area of historical significance adjacent to a future freeway in that city to Alan S. Hart (far right), Assistant State Highway Engineer, District III.



in terms of money which the land will bring if exposed for sale in the open market with a reasonable time to find a purchaser, buying with full knowledge of all the uses and purposes to which it is adapted and for which it is capable of being used."

In fairness to all taxpayers, this "fair market value" appraisal is uninfluenced by the owner's skill at bargaining.

Although the Right of Way Department has for the past decade leased space under certain freeways for private parking and open air storage purposes, space under interstate freeways was previously restricted to public parking.

The Highway Commission in April, acting pursuant to 1961 enabling legislation, authorized the department to lease space above as well as under freeways for commercial purposes, provided highway safety is adequately protected and local zoning regulations are not in conflict.

Similar leasing of space above and below interstate freeways was authorized by the federal government last May.

Landscaping and Planting

The Division of Highways planted 374,850 assorted trees and shrubs and 4,199,940 ground cover plants and cuttings in fiscal 1961-62 to improve the esthetic appearance of freeways, provide erosion and weed control and promote traffic safety.

In addition to landscaping and functional planting (planting for erosion and fire control, the delineation of structures, and the reduction of traffic noise and headlight glare), a tree planting program was begun in fiscal 1961-62 to replace trees removed by highway construction and to improve the appearance of highways where more expensive landscaping and planting are not justified.

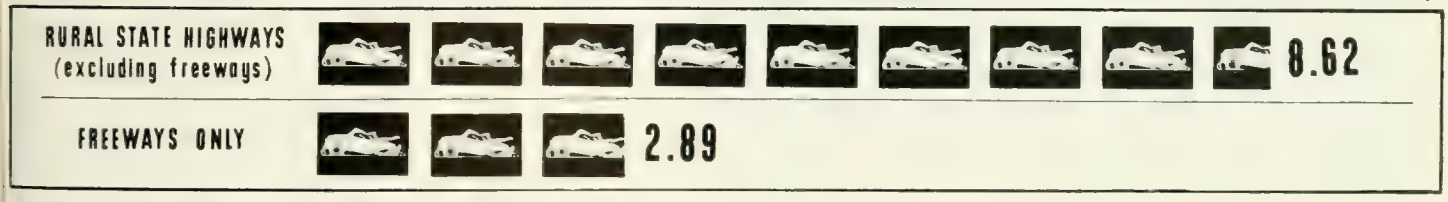
The trees selected will restore the native appearance to the area, and, in keeping with local conditions, will not require maintenance after they become established.

A total of $3,176,000 is provided in the 1963-64 budget for 29 landscaping, functional and tree planting projects.

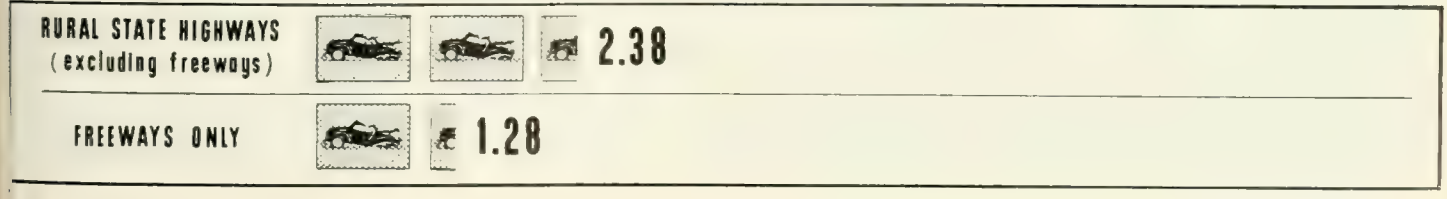
Scenic Highways

A preliminary report on a proposed system of scenic highways, prepared by an interdepartmental group composed of representatives of the Depart-

FATALITY RATE PER 100 MILLION VEHICLE MILES (1957-1961 AVERAGES)



ACCIDENT RATE PER MILLION VEHICLE MILES





While the safe and efficient movement of traffic is the major mission of the Division of Highways, consideration is given to esthetic values in freeway construction. The photo above shows the pleasing effect obtained by landscaping a section of the Colorado Freeway in the Pasadena area. The completion of a parallel freeway section on the Redwood Highway (U.S. 101) near Myers Flat has removed through traffic from the famed Avenue of the Giants (below). Motorists may travel at leisure along this inspiring route.



ment of Public Works, the Division of Beaches and Parks and the State Office of Planning, was presented to the Legislature in March, 1962.

The report suggested that 5,000 miles of highway, most of them in existence, be designated as "scenic" as they traverse areas containing "outstanding views, flora and geology and other unique natural attributes and historical and cultural resources affording pleasure and instruction to the highway traveler."

Well publicized workshop sessions were held in the various highway districts in September and October to obtain maximum local participation and to discuss city, county and state responsibilities in preserving the scenic values of selected corridors as the basis for further legislative consideration in 1963.

Contract Data

During the 1961-62 fiscal year, the Division of Highways opened bids on 560 projects with an estimated construction value of $352,095,200, including construction engineering. Of these 560 projects, contracts were awarded for 525 projects with a value of $346,890,900 and bids not in the best interest of the State were rejected on 20 projects. The 15 remaining projects were awarded after the close of the fiscal year.

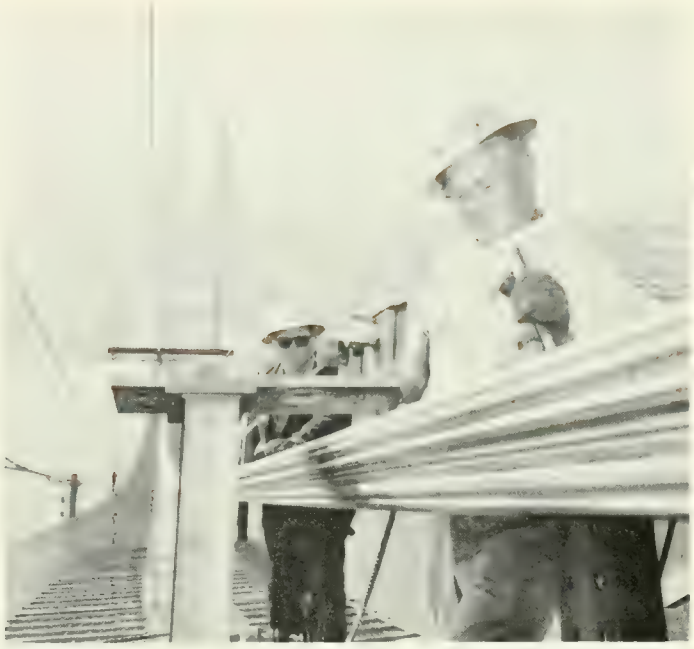
Contracts also were awarded during the year for 18 projects valued at $20,137,600 on which bids had been received during the previous fiscal year.

The total of $367,028,500 in contracts awarded during the year was made up of $333,586,200 for construction on state highways; $14,643,100 for work on county roads including the federal-aid secondary system; and $18,799,200 for maintenance and emergency repair, and work for other agencies.

The state highway system contracts of $333,568,200 consisted of $204,001,800 from the 1961-62 budget, and $129,584,400 from the 1962-63 budget which were awarded under statutory provisions permitting the award of contracts as early as January 1, six months before the start of the fiscal year.

The contracted state highway work involved improvement of 1,736 miles of highways and construction of 524 bridges and separation structures.

Construction Progress



Work continues on the superstructure of the Vincent Thomas Bridge between San Pedro and Terminal Island. The bridge will be opened to traffic early in 1964.

With projects underway ranging from such major jobs as the construction of the Webster Street Tube in Alameda and the San Diego Freeway through the Santa Monica Mountains to the relatively minor widening of a rural highway and installing channelization at an urban intersection, the State's highway construction program seeks the maximum traffic benefit from available highway user funds.

The program is balanced not only between the various areas of the State but also between relieving present deficiencies and constructing for tomorrow's needs.

San Diego Area

U.S. 101 (Interstate 5) occupies the construction spotlight in San Diego County with 12 major projects either recently completed, under construction, or budgeted for the current fiscal year.

Two recently completed contracts provided a full freeway in U.S. 101 from Palm Street to the four-level interchange with U.S. 395, also completed this year.

Three projects under construction will extend the freeway southerly between San Diego and National City and connect with the Montgomery Freeway leading to the Mexican border. Provision is made in the new budget to widen the Montgomery Freeway in National City and to connect the new freeway in San Diego with Pacific Highway at Washington Street.

Completion of U.S. 101 to interstate freeway standards from San Diego north toward Carlsbad depends on the time required for the settlement of foundation fills across coastal lagoons, now under construction. A $4,900,000 freeway section in the Del Mar-Encinitas area is budgeted for fiscal 1963-64.

Current or recently completed construction, supplemented by newly budgeted projects, will provide 10 miles of freeway in the Mountain Springs area on U.S. 80 (Interstate 8) near the San Diego-Imperial county line; four more miles on the same route easterly from El Cajon; and the



The entire length of U.S. 40 (Interstate 80) between Sacramento and the Nevada line will be raised to multilane freeway and expressway standards by 1964. At left, westbound lanes near Emigrant Gap are nearing completion. The existing highway (lower level at left) will be reconstructed and widened on the same general alignment at this point to serve as the eastbound lanes.



Shown above is a section of the Crosstown Freeway in San Diego which was opened to traffic in June. It turns left at center of photo to interchange with the Cabrillo Freeway (U.S. 395) at the south end of Balboa Park (left center). The Crosstown is a section of the San Diego Freeway which eventually will run from the San Fernando Valley in Los Angeles County to the Mexican border.



Above is a section of the Santa Monica Freeway serving the downtown Los Angeles business district, which opened in March. The new freeway will be extended to the Pacific Coast Highway at Santa Monica.

final unit of a midcounty freeway and expressway connection on State Sign Route 78 between U.S. 101 at Oceanside and U.S. 395 at Escondido.

Los Angeles Metropolitan Area

The earliest freeways in Metropolitan Los Angeles converged on the city's central district. This year saw completion of the first freeway bypass of the congested business section, and construction emphasis in the next several years will be on interconnecting freeways toward the area's periphery.

The most significant single event in the area was the opening to traffic in March of the 23-mile freeway loop, encircling the downtown business district, formed by the junction of the Golden State and Santa Monica freeways (Interstate Routes 5 and 10). By means of the East Los Angeles Interchange, the freeway loop provides direct connections with the Santa Ana, San Bernardino, Pasadena, Glendale and Harbor freeways, and indirect connections with all other freeways in the region.

By offering motorists alternative routes, the loop has succeeded in markedly relieving traffic congestion on the older four-level interchange (Harbor - Hollywood - Pasadena freeways), which in 1961 carried 343,000 vehicles a day, and has reduced traffic on the Hollywood Freeway by 16 percent in the downtown slot.

The Golden State Freeway now extends northwestward to Lankershim Boulevard in San Fernando Valley and has eliminated most of the traffic congestion on San Fernando Road and Riverside Drive.

The Santa Monica Freeway, opened to traffic from the East Los Angeles Interchange westward for 4.3 miles in December, is under construction to the San Diego Freeway. A final segment to link the Santa Monica Freeway with the Pacific Coast Highway in Santa Monica is financed in the 1963-64 budget.

Approximately 45.2 miles of the San Diego Freeway (Interstate 405) were completed by year's end. As a fitting climax, the last of this mileage was in the largest project—a $20,000,000 section from West Los Angeles across the Santa Monica Mountains to the San Fernando Valley. This job is one

of the most impressive ever undertaken in Southern California in terms of cost and amount of earth excavated; approximately 18 million cubic yards of earth were moved.

The San Diego Freeway has now been completed or is under construction from its junction with the Golden State Freeway in San Fernando to Westminster in Orange County. The 1963-64 budget provides $8,900,000 to extend it southeasterly to Huntington Beach.

Bids for the first project on the San Gabriel River Freeway (Interstate 605) were opened in November. This 22-mile route will connect the San Bernardino Freeway in El Monte with the Garden Grove Freeway in Westminster. The eight-mile section from Whittier north to the San Bernardino Freeway was financed previously, and another 11 miles from Whittier south to Dairy Valley are financed in the new budget at a cost of nearly $30,900,000.

The final link of the Harbor Freeway, the most heavily traveled highway in the world with an average daily count of 200,000 vehicles near downtown Los Angeles, was opened to traffic in October, completing the $103,500,000 route between the Los Angeles Civic Center and Battery Street in San Pedro, a distance of 22.6 miles.

Of the 51 miles of freeways in this area opened this year, 10.8 important miles on three routes were completed in September alone.

A 2.8-mile segment of the Ventura Freeway, completing the stretch from its junction with the Hollywood Freeway to an interchange with the Golden State Freeway, affords motorists an alternate route to downtown Los Angeles and has relieved traffic conditions on the Hollywood Freeway.

A 4.5-mile freeway loop around the business district of the City of Ventura was hailed by the mayor as of "more significance to us than the coming of the railroad in 1886."

A 3.5-mile stretch of the Newport Freeway completed this route between the Riverside and Santa Ana Freeways in Orange County. It will be extended southerly to connect with the Pacific Coast Highway at Newport Beach.



The MacArthur Freeway (Interstate 5W) was opened to traffic from the distribution structure near the San Francisco-Oakland Bay Bridge to Grand Avenue in Oakland in May. Construction is continuing through Oakland and San Leandro.

Work on the substructure of the San Pedro-Terminal Island Toll Bridge, the first toll bridge in Southern California, was completed this year and construction is progressing on the superstructure, with completion scheduled for January 1964.

The first project on the Pomona Freeway, which will parallel the San Bernardino Freeway for the 30 miles between Los Angeles and Pomona and relieve traffic on the older route, has been financed at an estimated cost of $8,400,000. It is for 3.4 miles of eight lanes between the East Los Angeles Interchange and Third Street in East Los Angeles.

San Bernardino-Riverside

A freeway through Redlands on U.S. 70-99 (Interstate 10) was opened to traffic in August, now providing 125 miles of continuous freeway and expressway between downtown Los Angeles and Indio. A five-mile segment of six-lane freeway on U.S. 60-70-99 (Interstate 10) between Banning and Cabazon is in the current budget.

Two projects on Interstate 10 in the new budget, with an aggregate cost of $10,700,000, will convert the nearly 12 miles between Redlands and Beaumont from four-lane expressway to six-lane freeway, and will provide 10 miles of four-lane freeway on U.S. 60-70 slightly east of Indio.

Freeway construction is underway on the Barstow Freeway (U.S. 91-466, Interstate 15) between the Nevada state line and 23 miles southwesterly, connecting with a 25-mile segment completed last year east of Baker. Work began on another 24-mile unit of this route east of Barstow in November.

A 5.6-mile freeway section was completed in November on U.S. 60 in and west of Riverside, and another 4.8 miles is under construction through Sunnymead. The latter job will be extended to State Sign Route 79 by a project on which bids were opened in December.

Central Coast Counties

Completion of the 10-mile freeway bypass of Santa Maria together with a 2.3-mile freeway project under construction in Santa Barbara will eliminate two more of the few remaining gaps in U.S. 101 freeway and expressway through Santa Barbara County.

Work progresses on the Ward Memorial Freeway which will link the University of California Campus at Goleta with U.S. 101 near the southern end of an 8.5-mile freeway project completed in May.

One interchange was completed and three more are under construction on U.S. 101 in San Luis Obispo County to convert expressway sections to full freeway.



ABOVE—The Southern Freeway in San Francisco, which will roughly parallel Alemany Boulevard, is under construction from the James Lick Memorial (Bayshore) Freeway (upper center) to Orizaba Avenue. It will be continued by funds in the new budget to connect with the Junipero Serra Freeway (Interstate 280) in Daly City.

BELOW—Sixteen miles of the Antelope Valley Freeway (U.S. 6), which will run from the Golden State Freeway to the Kern County line north of Lancaster, are under construction and another eight miles are financed in the new budget.



Two two- and four-lane expressway projects on State Sign Route 1 between Morro Bay and Cambria will be completed early next year, and work has just started on a two-lane expressway bypassing Cambria. A four-lane freeway for 2.8 miles on this route near Cayucos is financed in the new budget.

The six-mile freeway bypass of Gonzales on U.S. 101 in Monterey County is nearly completed, and construction has begun on an 11-mile freeway section between north of Bradley and south of San Ardo.

Four more freeway projects on U.S. 101 in Santa Barbara, San Luis Obispo and Monterey Counties are in the 1963-64 budget at an estimated $8,700,000.

San Francisco Bay Area

The first three units of the Southern Freeway (U.S. 101) are under construction between the James Lick Memorial (Bayshore) Freeway and Orizaba Avenue in San Francisco.

A fourth unit is financed by the new budget as part of a $10,200,000 project to extend the Southern Freeway to the Junipero Serra Freeway (Interstate 280), and construct the latter freeway through Daly City.

Also under construction is the first unit of the Southern Freeway Extension easterly of the James Lick Memorial Freeway Interchange.

Construction is more than 50 percent complete on the first unit of the 19th Avenue Freeway in San Mateo. Bids were opened in October for a freeway on State Sign Route 1 in Pacifica.

Work began on the first 7.2 miles of the Junipero Serra Freeway in Santa Clara County in July.

The first three units of the MacArthur Freeway (Interstate 5W) from the distribution structure near the San Francisco-Oakland Bay Bridge to Grand Avenue in Oakland opened simultaneously to traffic in May. Another unit between Grand Avenue and Park Boulevard was opened in September. Construction is continuing on this freeway for another 9.5 miles through San Leandro.

The largest project underway in the region is the $17,000,000 Webster Street Tube, paralleling the existing

Posey Tube and connecting Alameda and Oakland. The new bore will be completed early in 1963, and, when revisions have been made to the ventilating, lighting and traffic controlling systems of the Posey Tube, each tube will carry two lanes of one-directional traffic.

The Benicia-Martinez Toll Bridge and a freeway (Interstate 680) connecting it with U.S. 40 (Interstate 80) near Vallejo opened to traffic in September. Three contracts totalling over $28,200,000 are underway for freeway sections on this interstate route on the southern side of the new bridge.

Work also continues on the third two-lane bore of the Caldecott Tunnel on State Sign Route 24 at the east city limit of Oakland and a connecting eight-lane freeway between the tunnel and Orinda Highway.

Nearly $17,500,000 is provided in the new budget for other freeway projects in Alameda and Contra Costa Counties, including portions of two major interchanges in Oakland and



A floating crane positions a temporary access cylinder above the last of the 12 precast sections of the Webster Street Tube between Alameda and Oakland. When the new bore is completed early in 1963, the parallel Posey Tube will be closed to traffic and renovated, after which each tube will carry two lanes of one-directional traffic.

Motorists in Los Angeles received a welcome Christmas present on December 21 when a $20,000,000 section of the San Diego Freeway from West Los Angeles across the Santa Monica Mountains (background) to San Fernando Valley was opened to traffic. Approximately 18 million yards of earth were moved for this project.



three miles of six-lane facility on State Sign Route 21 (Interstate 680) north of Dublin, which will include the interchange with U.S. 50 (Interstate 5W).

Two major freeway projects on U.S. 101 in Marin County totalling approximately $7,500,000 were advertised for bids this fall.

Two freeway sections on U.S. 101 between Santa Rosa and 15 miles north in Sonoma County were opened to traffic in November, and work is underway on the first 5.5 miles of the State Sign Route 12 Freeway westerly of Santa Rosa, including a three-level interchange with U.S. 101.

Construction started this fall near Asti on a 3.6-mile freeway section of U.S. 101, with another section to the south financed in the new budget.

North Coast Counties

A contract for completion of 13 bridges between Ukiah and Calpella on U.S. 101 in Mendocino County is



Illustrating some of the problems encountered in the construction of the Redwood Parks Freeway through rugged country is this view of the Eagle Point Viaduct in Humboldt County. This 16-span bridge structure will carry four freeway lanes on a 56-foot roadway for a quarter-mile.



This view looking westward shows construction on the westbound lanes of the Yolo Causeway on U.S. 40 (Interstate 80) which has replaced the three-mile structure on the right, once the longest highway trestle in the world. The eastbound lanes will carry two-way traffic until construction is completed in 1963.

nearing completion and the freeway that will include these structures is under construction as is a freeway section to the south between six miles north of Hopland and Ukiah.

Two projects are under construction for 11.6 miles of freeway on U.S. 101 in Humboldt County between 3.6 miles south of Phillipsville and Myers Flat at an estimated cost of $12,100,000. These sections connect with 12 miles of the Redwood Parks Freeway between Myers Flat and Englewood completed previously.

The 3.9-mile U.S. 101 Freeway Bypass of Fortuna was completed in July. This project included the 1,000th completed freeway mile in the State.

Another two projects will provide 7.2 miles of freeway on this route between Loleta Drive and Elk River by next summer.

The Collier Tunnel and approaches on U.S. 199 just south of the Oregon border will be opened to traffic next summer, ending the steep and winding climb over Hazelview Summit.

North State Region

Two interstate routes, U.S. 40 (Interstate 80) and U.S. 99 (Interstate 5) had the greatest amount of freeway construction in Northern California this year.

Projects underway on U.S. 40 include freeway sections east of Vallejo through American Canyon; through Vacaville to State Highway Route 90 near Dixon; a new bridge-and-fill crossing of the Yolo Bypass (partly in operation) to replace the bottleneck of the narrow Yolo Causeway; and several projects in the Sierra Nevada connected with route relocation near and over Donner Summit.

One of these mountain jobs, a 5.4-mile section near Emigrant Gap, will be completed by next fall and another 6.3-mile section near Cisco Grove in 1964. One of two contracts for grading and structures on the 10.5 miles over Donner Summit was completed this year and the second will be completed by next summer. A total of $5,455,000 is contained in the new budget for the paving, which will complete a continuous freeway and expressway between Sacramento and the Nevada line.

More than $22,500,000 additional is in the new budget for a freeway conversion project southwest of Vacaville, and for the superstructure and freeway approaches of a new Sacramento River Bridge needed for the rerouting of U.S. 40 through Sacramento. Bids for construction of the substructure of the bridge were opened in December.

A 5.6-mile freeway project on U.S. 50 east of Sacramento was completed recently and work progresses on a 2.8-mile section west of Placerville.

Work has just been completed on a major freeway project on U.S. 99 (Interstate 5) south of Castella in Shasta County to provide 30 miles of continuous freeway and expressway in the Sacramento River Canyon.

Freeway construction is also underway on this route from Red Bluff north to Cottonwood, linking with a previously completed section from Cottonwood to Anderson; and along the shore of Shasta Lake between Pit River and O'Brien. Preliminary work for a 6.8-mile freeway relocation near Mount Shasta City has begun, and the new budget contains $4,800,000 to complete the project.

The new budget provides $7,700,000 for grading and structures for a future freeway section on U.S. 99 between north of Anderson and two miles north of Redding, along with a freeway section on State Sign Route 44 in and east of Redding.

Another $3,160,000 is budgeted for structures and approaches for a future freeway in the vicinity of Red Bluff on U.S. 99W (Interstate 5).

A two-lane expressway section on U.S. 299 east of Douglas City that was just completed will be extended another 2.1 miles easterly by funds in the new budget.

The first unit of a freeway on U.S. 99E through Chico is under construction for 1.3 miles, and a second unit for 2.6 miles to the south is in the new budget.

Other major projects completed in 1962 include the relocation of U.S. 40 Alternate (in connection with the Feather River Project) between Wicks Corner and Jarbo Gap in Butte County, including the construction of a bridge across the West Branch of the Feather River; and a two-mile freeway section on U.S. 40 Alternate southwest of Oroville.

A 6.8-mile freeway is under construction linking the above two projects.

Two-lane expressway projects recently completed include 5.8 miles on U.S. 299 east of Canby in Modoc County, including a new Pit River Bridge; two projects on U.S. 395 in Lassen County, one near the Modoc county line and the other southeast of Susanville; and a 10.3-mile section on State Sign Route 89 between U.S. 99 and McCloud in Siskiyou County.

Foothill and Mountain Routes

Completion this fall of an additional 5.6 miles of freeway on U.S. 466 west of Tehachapi in Kern County extended a 12-mile project opened last year. The new budget provides $4,100,000 for grading for a future 7.6-mile freeway extension toward Tehachapi.

A contract for freeway relocation on U.S. 395 to improve crossing of the Conway Summit in Mono County was completed in October. A two-mile two-lane expressway on Tioga Pass Road (State Sign Route 120) east of Yosemite National Park has been budgeted for fiscal 1963-64.



At bottom of photo, the U.S. 101 Freeway through the City of Ventura breaks away from the old highway which traverses the business district. Part of the new freeway, at upper right, was completed in September.

Two-lane expressway construction is under way on projects on State Sign Route 108, west of Twain Harte and east of Long Barn in Tuolumne County; on State Sign Route 88 above Peddler Hill in Amador County and from east of Picketts to Woodfords in Alpine County; and on State Sign Route 49 between Sierra City and Bassetts in Sierra County.

A widening project on State Sign Route 28 between Tahoe City and the Nevada line was completed this summer.

San Joaquin Valley Area

A 13.3-mile section of the Bakersfield Bypass on U.S. 99 was opened to southbound traffic in August. The northbound lanes of this section will be opened when the final 5.3-mile section of the bypass is completed next October. The combined construction cost of these two sections will be more than $13,000,000.

Other current projects in Kern County include an 8.8-mile freeway conversion job about 20 miles south of Bakersfield and a 3.3-mile section near MacFarland. Bids were opened in November for another nine-mile freeway conversion project north of Bakersfield between Minkler Spur and Lerdo Highway.

The new budget provides funds to convert U.S. 99 from four-lane expressway to eight-lane freeway between just north of the Los Angeles county line and Fort Tejon, connecting with the new eight-lane Grapevine section.

Two projects in Tulare County, just completed, have converted another 19 miles of U.S. 99 expressway to full freeway. One is just south of Tulare, the other between Goshen and Traver. In Fresno County, a total of 15.2 miles of this route in and south of Fresno is being relocated on a full freeway basis.

Another major freeway project is underway on State Sign Route 198 west of Lemoore in Kings County near the new Naval Air Station.

Freeway projects budgeted for the 1962-63 fiscal year include a short section on U.S. 99 in Tulare County immediately south of the Fresno county line; 5.5 miles on U.S. 99 south of Madera; 2.5 miles on U.S. 99 south of Modesto; converting 6.7 miles of U.S. 99 from four-lane expressway to six-lane freeway between the Calaveras River north of Stockton and existing freeway construction near Lodi; 5.4 miles on State Sign Route 198 in Visalia, and 3.9 miles on State Sign Route 190 near Porterville.

Construction is under way on freeway projects on U.S. 99 through Merced, Modesto and Lodi. A 2.2-mile freeway section just south of Modesto was opened in November.

Summary

While major emphasis in 1962 was placed on the 12,414-mile freeway and expressway system, particularly on the Interstate System routes, this construction was balanced by highway improvement projects on local service and feeder roads.

The principle of stage construction was employed to get the most in traffic safety and efficiency from available funds for current needs, while providing for future upgrading of highway facilities to meet the demands of 1980 when the State's population and vehicle traffic will double.

Many road sections were built as two-lane expressways with provision for future interchanges to convert them to multilane full freeway standards. Freeway sections were constructed with four and six lanes within rights-of-way that permit future widening.

The goals of the Division of Highways and the California Highway Commission continue to be safety, convenience and mobility for the motorist and freer traffic flow in 1980 than exists today.

The narrow, inadequate two-lane highway on the lower level was U.S. 99 (Interstate 5) south of Castella in Shasta County. Construction has just been completed on the section to its left, which provides 30 miles of continuous freeway and expressway in the Sacramento River Canyon. Freeway construction is under way on this route north of Red Bluff and along the shore of Shasta Lake, and is budgeted for construction near Redding and Mount Shasta City.



Operations

The construction, maintenance, equipment and materials and research departments are administered under the direction of the Assistant State Highway Engineer—Operations

CONSTRUCTION

Administration of construction contracts, except for those comprised primarily of structures and administered by the Bridge Department, is the responsibility of the district in which the project is located.

This assignment is accomplished through the teamwork of a staff of engineers, technicians and others whose primary duties are to assure that the terms of the contracts are met. This involves interpretation and enforcement of specifications and plans.

Such activity requires the services of many specialists; men who are proficient in many fields such as contract administration, paving, earthwork, drainage, materials testing, and surveying. A continuous training program is carried on to provide and maintain this staff.

The total personnel engaged directly in the construction function in the 11 highway districts exclusive of bridges, is about 2,600 in the peak of construction months. This encompasses work on more than 300 major contracts, valued at over a half a billion dollars.

Grading in rugged terrain for the south approach to the Randolph Collier Tunnel on U.S. 199 in Del Norte County near the Oregon line.



To assist in the uniformity of specification interpretation and construction practices, and provide assistance on special problems, the Headquarters Construction Department performs, as a staff activity, an on-the-job reviewing service of all construction projects.

Construction progress was seriously hampered during May and June by a labor dispute, particularly in the northern part of the State.

Special Projects

A new contract record procedure was initiated by the Construction Department in July 1961. Headquarters construction personnel held training sessions on the new procedure in the districts and conducted frequent reviews of the procedure in operation in the field. Further improvements in the procedure are being made as a result of these field studies.

The department is also developing a system which will insure a more uniform method of indexing and filing for project control. This system will also furnish supporting data for the new contract record procedure.

The new, completely revised issue of the Construction Manual was published and distributed to division personnel, cities and counties of the State, other state agencies, federal government agencies and to the chief engineers of the other 49 states.

The study of tolerances in the various elements of the structural section of the roadway was continued during the past year. The goal is to determine reasonable tolerances which will accommodate modern, high-speed construction equipment and methods and still satisfy the structural requirements of the design. During the course of the study, there has been a noticeable improvement in the projects covered in the past year over those of the previous year.

Construction Practice

The slipform method of constructing portland cement concrete pavement was utilized extensively during the past fiscal year. Quality of the finished product continues to show improvement as the equipment is modified and refined and contractors gain experience in its use. During the year, about one-third of the concrete pavement was constructed by this method.

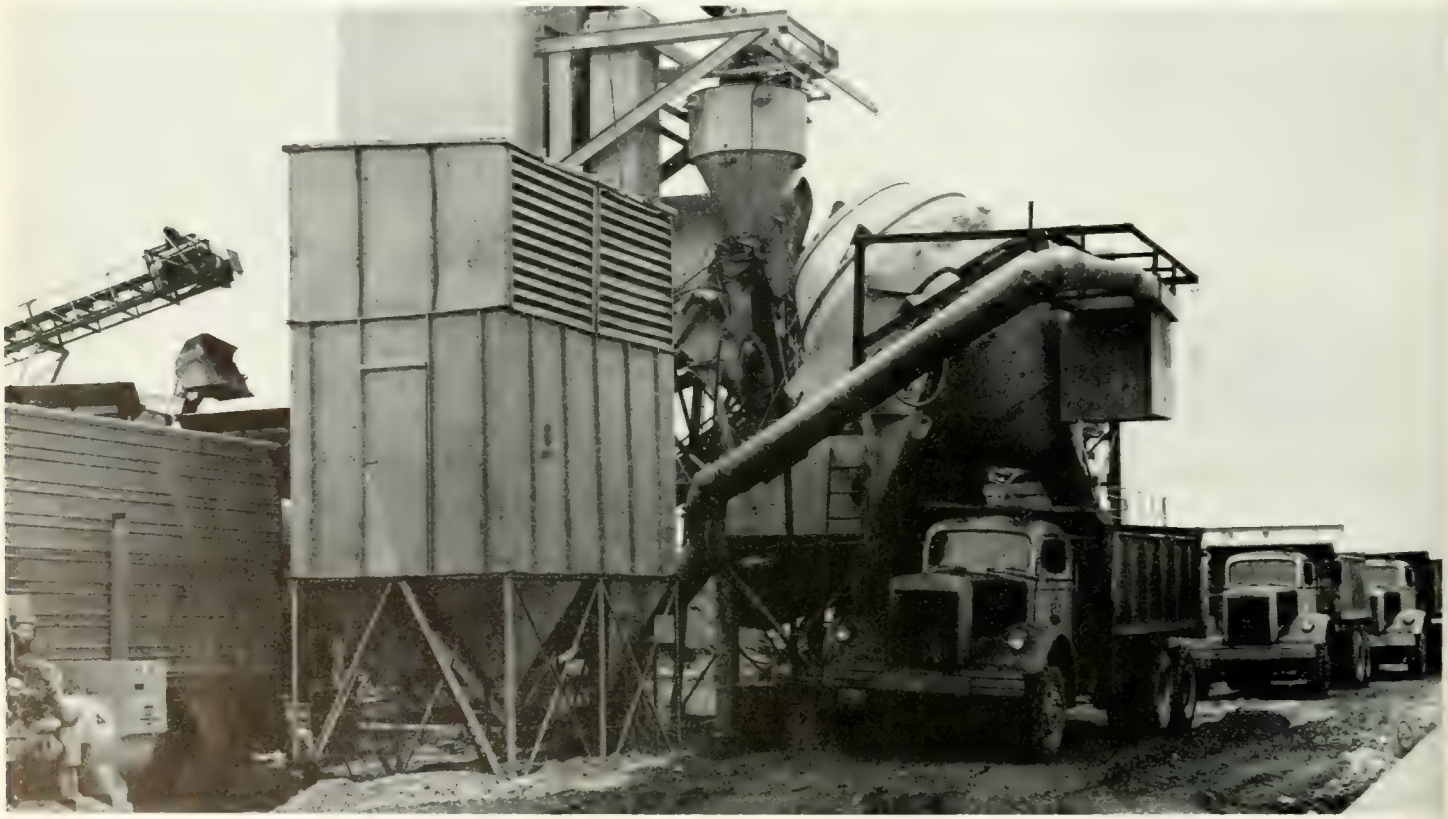


The road winding up the mountainside from left center is the recently completed Angeles Crest Highway in Los Angeles County. Barley Flat recreation area is off to right of photo. Higher level road is a former access road used during highway construction.

Central mixed concrete for portland cement concrete pavement was used on several state highway projects for the first time. This procedure calls for the concrete to be mixed at a central plant and hauled to the paving machine in nonagitating trucks, rather than the conventional method of hauling the dry batches to the mixers in the paving train. Results were very encouraging and more use of this method may be expected.

The trend to more automatic control of crossfall and profile grade obtained with asphalt paving equipment continues from preceding years. As more and more sophisticated automatic control equipment becomes available for routine construction use, uniformity and accuracy of geometric features in completed pavements is being maintained and in instances improved. This result is obtained despite the continuing high rate of construction activity and shortage of highly skilled operators.

Asphalt paving practices during the past year, and before, with respect to



The central mix method of getting concrete to a paving job was used successfully on a section of the San Diego Freeway in the Carson Street-Dominguez area of Los Angeles.

compaction procedures, reflect the effect of revised specification requirements. These requirements arose out of field and laboratory investigations into the effect of various types and degrees of rolling initiated in 1959. In general, it can be stated that asphalt pavements constructed under the current requirements have improved density and impermeability.

Honor Camp Projects

The Division of Highways and the Department of Corrections continued the joint operation of Honor Camp No. 37 at Cedar Springs, Los Angeles County; Camp No. 41 near Happy Camp on the Klamath River in Siskiyou County; and Camp No. 42 near Lord Ellis Summit in Humboldt County.

All work proposed for Camp 37 was completed in the late fall of 1961 and the camp facilities were demolished by the end of the fiscal year. Except for a period during the war years, this camp operated continuously from June 1940 until November 1961. A total of 32.2 miles of roadway was graded at an approximate cost of $9,000,000.

With the completion of this work, along with various sections built by the Bureau of Public Roads, the Angeles Crest Highway now provides a continuous route from La Canada to the Big Pines and Wrightwood recreation area. In addition, the motorist is now able to drive from Azusa through the San Gabriel Canyon to a junction with the Angeles Crest Highway at Islip Saddle, with completion of the work from Islip Saddle to a connection with the existing Route 62 at Crystal Lake.

Camp 41 continued construction on the nine-mile portion of the Klamath River Highway (State Sign Route 96) between Swillup Creek and Clear Lake. Oiling was completed on a four-mile length toward the east end of this section and heavy excavation is in progress in the westerly three miles. Clearing and building of drainage structures have been started in the first mile west of Swillup Creek. Grading was completed (including approaches for the Indian Creek Bridge) for the new road from 2¼ miles west to Happy Camp to 0.2 mile east of town. This section was oiled except for a short distance each side of the new bridge under construction.

Camp 42 continued work on U.S. Highway 299 between Blue Lake and Berry Summit. Of the total of 23 miles proposed, 2.4 miles have been brought to grade and paved, 1.6 miles have been brought to fine grade, 1.3 miles have been brought to rough grade with major stabilization performed; grading and stabilization work were in progress on another 1.2 miles; and clearing was proceeding on other portions.

MAINTENANCE

Maintenance of the 14,156-mile state highway system is handled by approximately 3,500 maintenance personnel divided into 60 field superintendents' territories. They are responsible for maintaining California's highways in serviceable condition. The total expenditure for all maintenance work on state highways, including the state highways in 340 incorporated cities, was $41,845,000 in 1961-62.

New Routes Maintained

A total of 132 miles of former county roads and city streets was taken over for maintenance in the 1961-62 fiscal year. Of this total, 90 miles and 42 miles were added to the state highway system by the 1959 and 1961 sessions of the State Legislature, respectively. The location and mileage of these roads follow:

Shasta and Lassen Counties: Route 83 near Old Station to Route 29 west of Susanville, 46.10 miles. *Kings County:* between Route 10 east of Hanford and Fresno county line, 8.98 miles. *San Bernardino County:* between the present terminus of Route 187 at East Road in Morongo Valley and Route 218 at Old Woman Springs Road near Yucca Valley, 10.55 miles. Also from Route 187 near Yucca Valley to Utah Trail Road in Twentynine Palms, 21.74 miles. *Riverside County:* between Route 78 near Aguanga and Route 64 east of Anza, 20.98 miles. *Plumas and Lassen Counties:* from Route 83 near Canyon Dam to Route 29 near Westwood, 11.65 miles. *San Diego County:* between intersection of Route 2 and Wabash Boulevard and junction of Route 77, 12.48 miles.

Snow removal and sanding icy pavements costs approximately $4,000,000 or approximately 10 percent of the maintenance expenditure.

Pavement Repair and Bridge Maintenance

Extraordinary maintenance of the traveled way and shoulders, including work in cities, under specific fund allotments during 1961-62, was $1,880,000. The cost of restoration of 1,048 miles of traveled way and 1,022 miles of shoulders was $1,509,000 and included in the above cost. Also included was $371,000 for seal coat contracts (asphalt and screenings) on 162.25 miles of roadway. Daily operations of a general maintenance type are not included in the above figures.

The annual resurfacing and delayed construction seal coat program totaled approximately $5,000,000 financed from construction funds and involved some 767 miles of highways throughout the State.

Repairing spalled joints in portland cement concrete pavements was continued by using epoxy resin and concrete aggregate. The use of this material results in opening up the repaired areas with a minimum of delay to traffic.

Repairs to bridges on the State Highway System cost $630,000 during the fiscal year. This includes $287,000 under contracts and $343,000 for work performed by state and city forces.

Ferry Operation; Maintenance in Cities, and Roadside Cleanup

The Benicia-Martinez Ferry, across the Carquinez Strait, continued in operation (until September 15, 1962) and during the year carried 111,452 vehicles and 142,185 passengers. The ferry was out of service five days in November 1961 for inspection and repairs. A small ferry operated on an abbreviated schedule for pedestrians during this period.

Despite educational efforts by public service and other organizations throughout the State, rubbish continues to be dumped or thrown on state highways. Removal of roadside litter and street sweeping cost $1,700,000 during the 1961-62 fiscal year.

Roadside Vegetation, Tree Care and Landscaping

Roadside vegetation control includes the care of plantings, trees, fire hazard reduction, noxious weed control and the overall care of native roadside grasses and brush.

As of January 1, 1962, special landscape personnel were maintaining landscaped rights of way covering approximately 2,400 acres along 209 miles, functional plantings of ground cover and trees on 1,700 acres along 232 miles, and screen plantings on 242 miles. Landscape and allied maintenance cost $6,400,000 during the fiscal year.

Service contracts with 32 County Agricultural Commissioners provided control of noxious weeds along State highways within their respective counties. In other counties highway personnel performed this work when required.

Mechanical and chemical brush control operations continued as a more economical means of controlling roadside vegetation, for fire prevention and to preserve sight distance.

As a more effective fire preventive method, wider treatment strips are now being placed adjacent to improved shoulders instead of a narrow strip farther away from the pavement. This makes it easier to prevent the escape of accidental roadside fires into adjoining flammable areas.

Some 5,000 roadside miles were treated at selected locations to reduce fire hazard. About three-fourths were treated chemically and one-fourth mechanically.

Experimental plots have been established on roadsides in co-operation with the chemical industry, Division of Forestry, University of California, and this department to determine the effectiveness, the methods and the economy of using plant growth inhibitors to reduce the amount of annual roadside mowing required; also to determine the effective materials and methods of application required for the use of chemicals on roadside vegetation as fire retardants. Landscape maintenance and roadside vegetation control accounted for $6,000,000.

Lighting, Signals, Electrical Devices

Another 149 traffic actuated and railroad or fire station pre-empted controller units were installed at intersections, during the past fiscal year, making a new statewide total of 1,479. These electronically operated controllers are used not only for regulating major and minor movements of highway traffic but also the movement of traffic while a train or fire truck has pre-empted the use of an intersection.

Thirty fixed-time controllers were eliminated or replaced during the past

The new Whitmore Maintenance Station on U.S. 40 east of Baxter will facilitate maintenance work along this important stretch of trans-Sierra freeway.



fiscal year reducing the statewide total to 578.

Some 81 electrically or electronically operated timers for controlling pedestrian crossing movements at intersections were installed during the past fiscal year making a new total of 1,281.

An additional 2,342 lamps used in highway lighting were installed during the past fiscal year, bringing the statewide total to 22,044. Some 2,260 of these were mercury vapor lamps; 82 were incandescent lamps. *No* fluorescent lamps were installed. The mercury vapor lamps vary in lumen output from 35,000 lumens to 6,800 lumens; the incandescent lamps from 15,000 lumens to 2,500 lumens and from 1,000 watts to 300 watts.

The number of lighting, signal, and illuminated sign facilities knocked down during the past fiscal year increased by 113 for a new total of 863 knockdowns per year. A knockdown is where a lighting pole, traffic signal pole, signal cabinet, or any other lighting, signal or sign facility is actually knocked down. It also includes situations where the lighting, signal or sign facility is damaged by a car or truck beyond what could be considered as part of regular maintenance. Maintenance of electrical safety devices accounted for an expenditure of $2,900,000.

Communications

Further improvements were made in the division's VHF mobile radio system during the past year in District VI (Fresno) and District IX (Bishop) to increase mobile radio coverage. Additional microwave installations were completed in District I (Eureka), District II (Redding), and District XI (San Diego) to provide multicontrol of remote mountaintop radio stations. The division also used radio communication on 10 major construction projects.

At the end of the fiscal year the Division of Highways was operating 200 land-based radio stations, 35 microwave stations, 100 hand-carry units and 1,200 mobile radio units.

The division continued operation of its leased, automatic, private-line teletypewriter system. This system connects all 11 of the division's district offices and certain other key locations



California National Guard shooting down snow cornices to prevent snow slides on U.S. 50 at Sierra Ski Ranch.



Chain control area in operation at south of Strawberry, U.S. 50.

Scenic Public ...
FEB 18 1963

with Sacramento. The system consists of a total of 20 stations.

The division continued to furnish road and weather information via teletype during the winter months to news media, radio and TV stations, automobile clubs, trucking concerns, governmental agencies, and other concerned organizations.

Outdoor Advertising

As in previous years, the regulation of outdoor advertising displays adjacent to the public highways within the unincorporated areas of the State has been administered and financed solely through revenue derived from license and permit fees.

Operations and enforcement activities were carried on at the increased level projected in 1959 when amendments to the Outdoor Advertising Act provided a necessary increase in the fee schedule.

For comparison, records covering the last three calendar and fiscal years are as follows:

Number of advertising operators licensed for each fiscal year:

1959-60	843
1960-61	838
1961-62	880

Number of permits issued during the calendar year:

	Signs	*Structures*
1959	714	36,425
1960	1,115	35,126
1961	972	34,357



A maintenance crew trim overhanging foliage from a tree along a state highway, one of the many routine maintenance chores that must be performed regularly.

Gross receipts – license and permit fees and penalties for each fiscal year:

1959-60	$109,180.24
1960-61	127,104.25
1961-62	124,693.32

Transportation and Encroachment Permits

Transportation permits for oversize or overweight vehicles processed during the past fiscal year increased slightly over the preceding period. About 7 percent more permits were issued as a result of 1961 legislation restricting the issuance of annual permits for oversize trailer coaches. The Los Angeles and San Francisco districts, in that order, continued to handle the largest volume of extralegal hauling permits, accounting for some 44 percent of the statewide total. Military certifications handled during the fiscal year increased about 20 percent, averaging about 43 cases per month.

The encroachment permit function experienced a slight reduction of 3 percent, with the two metropolitan districts handling about 50 percent of the total volume.

Following is a comparison of the number of permits issued for both functions during the past three fiscal years:

	1959-60	*1960-61*	*1961-62*
Encroachment permits	13,415	13,151	12,778
Transporation permits	92,156	70,306	75,603
Totals	105,571	83,457	88,381

Truck Scales

Two new truck weighing stations located at Galivan, five miles north of San Juan Capistrano, have been constructed on U.S. 101. Two new truck scale yards, between Cordelia and Fairfield on U.S. 40, have been completed and are now in operation. These truck weighing facilities are similar to the one located on U.S. 99, north of the Grapevine Canyon portion of the Ridge Route, near the community of Wheeler Ridge. The Highway Patrol is also utilizing these two stations to check brakes.

Maintenance Stations

Construction on the final phases of station facilities at Whitmore and Kingvale Maintenance Stations on U.S. 40 in the Sierra is rapidly nearing completion and will be ready for winter. Seven new maintenance sta-



One of the truck-weighing stations along state highways, this one on U.S. 99 north of the Ridge Route with Grapevine Canyon and the community of Wheeler Ridge visible in the background.

tions were placed under contract in Northern California and four were placed under contract in southern California.

Striping and Pavement Markings

Placing pavement markings and traffic stripes by state forces on some 14,000 miles of state highways cost approximately $1,537,000.

The changes in our traffic stripe program initiated in 1961 to conform to the revised *Manual of Uniform Traffic Striping Control Devices for Streets and Highways*, notably the use of yellow striping for no-passing zones, have been practically completed.

Continued use of thermoplastic materials, for pavement markings in both Districts IV and VII indicates that this material will provide a more thorough and lasting stripe in urban areas where restriping under normal procedures disrupts traffic and is rather expensive. Two new striping machines were purchased for the application of the thermoplastic striping in the two large metropolitan districts and surrounding districts.

Road Closures

The drought that has plagued the State for the past three years continued through the summer months of 1961 resulting in numerous forest fires throughout the State causing minor road closures. In the early part of November the disastrous Bel Air and Topanga Canyon fires in the Los Angeles area necessitated closure of Sepulveda Boulevard, Sign Route 7, and Topanga Canyon Road, Sign Route 27, for approximately 3½ days. The Pacific Coast Highway, U.S. 101 Alternate, was also closed for a short time to facilitate movement of fire-fighting equipment and evacuees. These extensive brush fires in the Los Angeles area resulted in huge property losses which prompted a disaster area declaration by the Governor on November 6, 1961.

The 1961 calendar year ended with a subnormal seasonal rainfall total and only minor road closures in the higher elevations. The Sierra and Southern California received a heavy snowfall during the first part of January, with snow falling in Southern California for the first time in years. The Sacramento and San Joaquin Valleys were blanketed with a heavy fog during this period, which caused considerable disruption to traffic. There were numerous accidents on the heavier travelled highways.

Major road closures from this storm occurred on Sign Route 32, Deer Creek Highway; the Emerald Bay Section of Sign Route 89; and Monitor Pass, Sign Route 89. The Los Gatos-Santa Cruz Highway, Sign Route 17, was closed due to snow on January 21 for 15 hours. U.S. 99 over the Ridge Route was closed on January 22 for 24 hours, and intermittent closures were experienced during the next two nights. Other state highways in the southern part of California were closed because of snow and ice conditions.

A series of heavy storms beginning the first part of February brought exceptionally heavy precipitation to most of the State and ended the indications of a fourth dry year. The Los Angeles area was deluged with 8 inches of rainfall in six days and 11

inches over a two-week period. While widespread damage from the heavy runoff resulted in a disaster area declaration by the Governor, state highway facilities were not particularly affected except for minor flooding in the low areas and miscellaneous slides in the mountains.

During February snowfall was recorded for 18 days of this short month in the Sierra. A snow slide east of Echo Summit on U.S. 50 necessitated opening the old Meyers Grade on February 8 as a detour for light traffic. High water in the Russian River at Guerneyville on Sign Route 104 closed this route to traffic for one day (February 13). Sign Route 1 south of Big Sur was closed by slides beginning February 10 for 10 days. Sign Route 198 east of Lemon Cove was closed by a large slide for four days beginning February 10. This route was also closed near Lemoore Naval Air Station for a total of nine days beginning February 9. Highway Route 100 was closed for a period of 10 days beginning February 10 due to extensive damage to the Steamboat Slough Ferry during the high-water period.

In March U.S. 50 traffic over Echo Summit was disrupted by a snow slide west of the summit. The road was closed for 37 hours beginning March 7 due to hazardous conditions, while the National Guard was called in to shoot down overhanging snow cornices with a 105-millimeter recoilless rifle. U.S. 50 approximately one-quarter mile east of Echo Summit was also closed by a large rock slide for one day, March 31.

Slides and Storm Damage

The storm pattern during fall and winter of 1961 shifted from north to south, with the result that slide and storm damage in the northern part of the State was below normal. The storm intensity in the southern part of the State resulted in severe damage, while the slide and storm damage throughout the State was below normal. A minor slipout occurred in the westbound lanes just east of the Whitmore Maintenance Station on U.S. 40 in Placer County and corrective measures are in progress.

CLOSING AND OPENING DATES ON MOUNTAIN HIGHWAYS

Route	*Name*	*Closing date*	*Opening date*	*Length of time*
SR 89	Lassen Loop	11-20-61	5-30-62 *	192 days
SR 89	Luther Pass	1-19-62	2- 1-62	13 days
		2- 9-62	3- 9-62 †	28 days
SR 88	Carson Pass	11-19-61	6- 7-62	200 days
SR 4	Ebbetts Pass	11-19-61	6- 1-62	194 days
SR 108	Sonora Pass	10-26-61	5-25-62 ‡	211 days
SR 120	Tioga Pass	11-19-61	5-23-62 §	186 days
SR 89	Monitor Pass	1-20-62	4-26-62	96 days
SR 89	Emerald Bay Section	11-30-61	1- 6-62	37 days
		1-18-62	4-18-62	90 days
SR 120	Big Oak Flat	11-20-61	4-20-62	152 days

* Temporarily closed five days in October.
† Temporarily closed for one day in March.
‡ Temporarily closed for four days in October and three days in May and June.
§ Temporarily closed two days in May. Tioga Pass in Yosemite National Park is maintained by the National Park Service.

Snow Removal

The subnormal storm pattern continued throughout the summer and early fall of 1961. An early snow storm during the latter part of October temporarily closed the major mountain passes. A series of late November storms resulted in above normal precipitation and heavy snowfall in the Sierra, with some 38 inches of snow on the ground at Donner Summit. However, the bad weather did not continue during the month of December, and the snow pack on Donner Summit had diminished to a mere 23 inches at the end of the year.

It was not until February 6 that a major storm covering the whole of the State brought heavy snowfall in the mountainous areas. During this storm blizzard conditions existed throughout the Sierra, and it was necessary to restrict travel due to poor visibility and drifting snow. The high winds caused drifting snow which built up cornices on the eastern slopes. This resulted in a snow slide just east of Donner Summit on March 1 in which a large cattle truck and trailer was swept over the bank. Approximately 75 head of cattle had to be destroyed as a result of this accident. There was 108 inches of snow on the ground on Donner Summit at the end of February. At the end of March an 85-inch snow pack remained at Donner Summit as compared with a 34-inch pack the previous season. A maximum snow pack of 135 inches was recorded on March 2.

Sanding operations during the next winter season will be implemented by the addition of a number of new sand houses constructed at critical locations on the state highway system in mountainous areas.



Advance signs chain control area Twin Bridges on US 50.

MATERIALS AND RESEARCH

The work assigned to the Materials and Research Department is carried on in five sections: *Administration and Services*, responsible for the general operation and supervision of the physical facilities of the laboratory and certain engineering services; *Foundation*, responsible for major foundation exploration; *Pavement*, which tests materials in the upper three feet of the roadbed; *Structural Materials*, is responsible for the inspecion and release of all highway materials prefabricated and delivered to the highway projects; and *Technical*, primarily concerned with cement, concrete and chemicals.

The types of work fall under four general classifications: standard procedures or routine testing, special investigations, research, and training.

Standard Procedures or Routine Testing

The routine work of the laboratory consists of all the tests and inspections required to determine if highway materials are suitable for use or comply with specifications. Approximately 50 percent of the department's work falls into this category.

The number of aggregate samples received and processed during the year increased 8 percent over the previous year. A total of 5,450 aggregate samples were received. Approximately 10,900 samples of asphalt were tested in the department's three asphalt laboratories located in Sacramento, Los Angeles and Bakersfield.

Most of the asphalt paving mixtures, base, and subbase samples are tested in the 11 district laboratories. However, in order to comply with federal requirements, a certain amount of the testing is required in Headquarters laboratory. Approximately 4,350 tests were performed in all.

During the year, 9,000 control tests were made on samples representing 2½ million barrels of cement to determine compliance with specifications. From structural concrete placed in highway structures and Division of Architecture buildings nearly 14,500 concrete cylinder specimens were tested for compressive strength. Large quantities of fabricated and manufactured products were tested, including nearly 2,000 tests made on the materials listed below:

Concrete pipe	423,447 linear ft.
Clay pipe	93,737 linear ft.
Steel pipe	412,578 linear ft.
Miscellaneous iron and steel	9,356,072 lb.
Treated and untreated timber	272,023 board ft.
Expansion joint filler	475,969 sq. ft.
Rubber waterstop	67,836 linear ft.
Corrugated metal pipe	544,786 linear ft.
Structural steel	75,692,779 lb.
Reinforcing steel	245,851,191 lb.

Numerous routine tests were made also on prestressing steel, structural steel, expansion joint, waterstop, bridge pads, barrier cables, electrical conductors, transformers, ballasts, traffic lamps, luminaires, and reflective tests were made on reflectors, reflective sheeting and tile. Miscellaneous items such as signs, traffic cones, porcelain enamel sheeting, reflector buttons, baked enamel sheeting, guide post plates, flagging, and even waterbags were tested to determine compliance with state specifications.

Source inspections were made in all areas of the State and assistance and



A fluorescent lamp being installed for testing in the integrating photosphere. The sphere is quite unusual, as there are only two or three others in the country which approach this unit in size.

consultation service was given to various construction engineers.

Exploratory borings, both vertical and horizontal, were made at many locations throughout the State—5,255 feet of hole were drilled for foundation investigations, 5,425 feet for cut slope designs, 370 feet for landslide correction, 2,100 feet for ground-water studies, 876 feet for materials site investigations, and 276 feet for other state agencies. A total of 9,283 lineal feet of horizontal drains were installed at three different locations. Embankment foundation reports were issued on 11 projects in 3 districts and a water tower study was made for 1 district.

In connection with foundation studies, 270 consolidation tests, 1,000 unconfined compression tests, and 325 triaxial shear tests were made on projects that were explored with Headquarters' drilling equipment. The geology unit made seismic investigations and geologic studies and gave recommendations for cut slope designs for a number of major projects.

Another major facet of the Materials and Research Department's routine operations last year was the record sampling and testing of completed work. This accounted for 2,500 aggregate samples from 142 different projects. 1,563 individual audit samplings representing 1,113 lane-miles of construction were taken. At each sampling location thickness measurements of each element of the structural section were made and the materials were tested to confirm their compliance with the specifications.

The primary function of district laboratories is to develop materials sites, determine the character of soils to be excavated and used along highway alignment, determine fill slope designs, recommend foundation drainage systems, and perform control tests to determine compliance of contractor-produced materials with the job specifications. The division's 11 districts performed a total of 166,336 record tests on soils and aggregates last year.



The first of its kind to be built, this water load counter was designed by the Materials and Research Department for installation on water trucks used in highway construction.

Special Investigations

Studies using the traveling deflectometer to measure pavement deflection under a 15,000-pound axle load were made on 30 projects totaling 171 miles. From these data recommendations were made concerning reconstruction and thickness of layers needed.

Several projects were investigated to determine the cause and extent of road distress. One investigation was made concerning the movement of concrete slabs. On another project a study was made to determine the cause of aggregate degradation. In still another case an investigation was made to determine the cause of asphalt flushing on certain roads in desert areas, and several times during the year studies were made using the skid tester, designed by this department, to determine skid resistance at specific locations.

A number of investigations were made to determine the cause and extent of distress in various concrete structures. A study was made on the effectiveness of epoxy paints as a tunnel lining coating; new methods of cleaning soot on ceramic tile in tunnels were investigated and a study was made of the efficiency of the vent system in the Posey Tube using titanium chloride and ammonia vapors to determine the direction of air currents.

The loss of stress in posttensioned strands and various other problems in connection with prestressed concrete fabrication and construction were the subjects of study; sound level studies



An inspector checks concrete beams, which have been subjected to wet and dry cycles and long-term exposure in soils containing high percentages of sodium sulfate. The beams, tested in co-operation with the Portland Cement Association, have been in the "duck pond" since 1945.

in buildings and at various freeway locations were made; corrosion of reinforcing steel was studied at various locations; and problems related to fabrication of welded steel structures were the subject of still other investigations.

Research

During the past year research, involving materials from over 200 sources, was completed on the development of a test method for measuring the resistance of aggregate to degradation. Studies were conducted using nuclear equipment for determining moisture and density in fills. Work continued on a study to investigate the possible aid to the compaction of the fills through the use of wetting agents. Work also continued on the experimental sand drain fill at the west approach to the Napa River Bridge. A simplified type of foundation deformation device was developed to indicate when a foundation soil starts to move in a horizontal direction. The device, called an inclinometer, has proved successful in indicating when fills constructed upon poor foundations become unstable. The installation of inclinometers is now routine where stability is of concern.

A field and laboratory study has been continued to learn more about the relationship between wear and polish of pavement surfaces and skid resistance. Rejuvenation agents for asphalt pavements have been the subject of one new study and research was begun on an experimental section of a heavily traveled road in District X to evaluate the effect of adding asbestos fibers and limestone filler dust to asphalt concrete.

The work of correlating laboratory research resilience tests with field performance was continued over the past year and, as a part of the long-range asphalt durability study, a followup survey of the Zaca-Wigmore test section in Santa Barbara County was made.

The effect of various amounts of chloride ion on California cements is the subject of a current research project. In another cement research project work was completed on the development of a test to limit the contraction and expansion properties of California cement. The requirements of this latter test have been incorporated into the specifications.

The laboratory's truck - mounted profilograph was modified to record two wheel tracks simultaneously, thereby reducing the amount of time necessary to obtain pavement profiles. At the same time cross-slope and longitudinal grades can also be measured and recorded.

A new piece of equipment known as the linear transverse machine has been installed and will be used to determine the amount and distribution of air entrained in concrete. New traffic paint formulations and thermoplastice hot-melt materials for traffic stripes have been investigated. The



Thermoplastic striping unit placing crosswalk markings.



Before a new device or testing unit can be adopted for general use, its relative merits and capabilities must be evaluated. Here a nuclear device for measuring soil density is being tried to determine its reliability for compaction control work.

study of reflective pavement markers was continued as was the effort to learn more about the effects of dew condensates on the corrosion of painted structural steel surfaces.

A test program evaluating new designs for bridge deck expansion joints was initiated. In addition several experimental installations were made using new joint sealants for bridge decks. The use of roller bearings in bridge bearing assemblies was investigated, and tests were performed to determine the shear resistance of bolts and face plates cast in reinforced concrete. Preliminary work was done on the instrumentation of the Webber Creek Bridge spans in El Dorado County to determine stresses and strains for future use in design and specifications.

Work was started on the development of an instrument to evaluate riding qualities of pavements by measuring the responses of both vehicle and passengers to different road surfaces. Several new types of signal and lighting equipment were tested and rated.

A new test was developed which predicts the service life of underground pipe from environmental factors (pH and soil resistivity). This test is now in use by all districts. A new test method was developed to measure the service life of concrete piles, based upon certain relationships between factors such as cement and water content, thickness of concrete cover over reinforcing steel, etc., and the corrosion potential of the reinforcing steel. Test installations of aluminum culvert pipe for comparative corrosion tests were completed and periodic observations were started.

Continuing investigations were made on new sign and marker materials. Welding tests were conducted and analyzed to relate the fillet weld bend test to shear strength of welds. Investigations continued on the ultrasonic testing of fillet welds. Research to solve problems concerning the use of new low-alloy high-strength steels was instigated.

Training

Last year 70 Division of Highway engineers and four county engineers attended the Materials and Research Department's training course "Procedures, Testing Methods and Use of

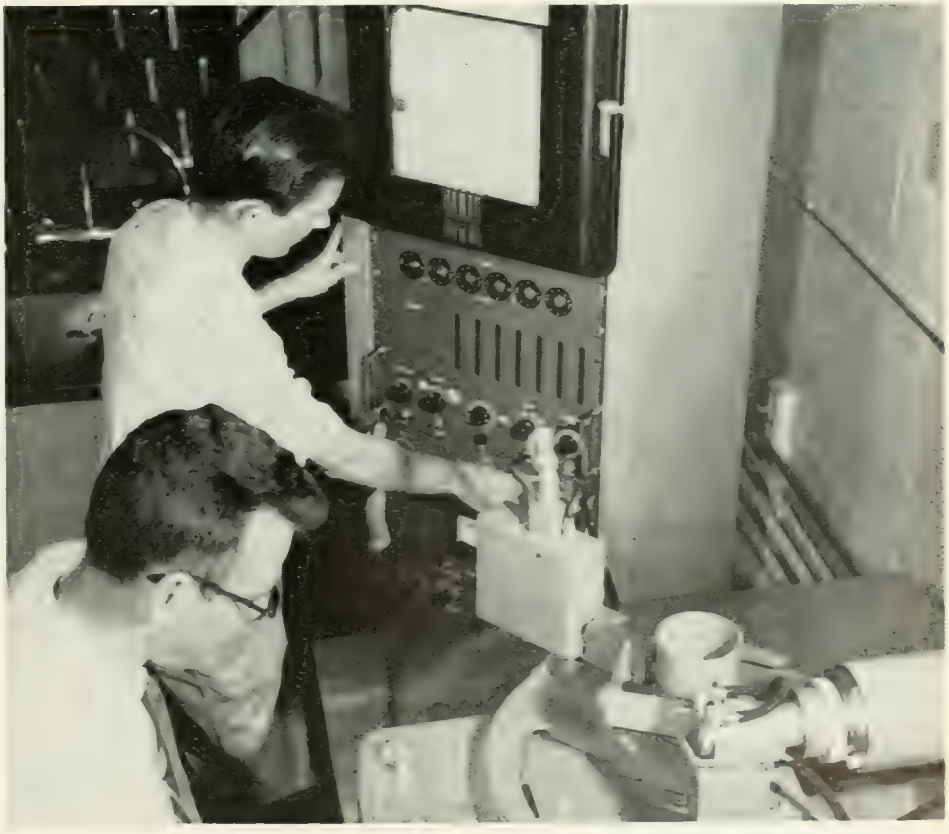


"Undisturbed" tube samples of soil are carefully sealed and labeled in the field for shipment to Headquarters Materials and Research Department Laboratory.

Materials for Highway Purposes." Six Bureau of Public Roads engineers also took the course. In addition to the formal training course special tours and training courses were arranged for 116 visitors, 51 of them engineers from 20 foreign countries.



Linear traverse device used in determining the entrained air content of hardened concrete.



The X-ray Diffraction and Spectroscopy Unit is employed in the analysis of soils, cements, paints, alloy steels, and a number of other items. Often trace elements amounting to one part in 10 million can be detected.

EQUIPMENT

The Equipment Department's primary responsibility is the acquisition, maintenance and eventual disposal, when obsolete, of the automotive and construction equipment required by the California Division of Highways for its steadily increasing workload. This fleet at the end of the 1961-62 fiscal year was comprised of a total of 9,400 units, composed of 6,075 automotive and 3,325 construction units.

The Equipment Department's operations are financed by a uniform system of equipment rental, charged to the department or district using each unit. The rental rate assessed each unit of equipment is based on its first cost, maintenance cost expectancy and a proper proportion of administrative overhead. These rental charges, plus the funds derived from the sale of retired equipment, usually cover the cost of replacement. Rental rates are a subject of constant review to keep them realistic and appropriate.

The physical plant consists of 12 major shops and 14 subshops serving the needs of the 11 highway districts and the Division of Highways Headquarters. These shops also handle certain special work, such as maintenance and repair of movable span bridges, pumping stations, state-owned ferryboats, light plants and other miscellaneous items as required by the Operations Department. Field forces are provided to accomplish emergency repairs on the road.

Equipment Design and Construction

Changing conditions require constant updating of methods and additional specialized equipment. When this equipment is not available on the open market, it is designed and constructed by the Equipment Department in collaboration with the districts or other departments. The Equipment Department has a design section for designing improvements to existing equipment and standardizing new equipment.

During the past year loaders have been standardized in regard to weight, horsepower, bucket and crane capacity to take better advantage of competitive bidding. The tree trimmer, cargo special, and cargo trucks have been modified to provide standardized accessories on all units.

Rising wage costs have emphasized the need for more efficient equipment. Increased roadside planting requires water trucks capable of watering planted areas at a rapid rate. During the past year, this need was filled by the development of both 4,000-gallon and 2,000-gallon semitrailer units. These units are equipped with pressure pumps, spray bars, hose and other auxiliary equipment to permit their operation by one man. The basic pieces of equipment were originally aviation gasoline-dispensing units acquired through federal surplus at a considerable saving.

During the past year, the Maintenance Department has found through



A 2,000-gallon semitrailer watering unit constructed at the headquarters shop from a surplus gasoline tanker.

experiments that, where the average daily traffic volume is high, thermoplastic material provides more economical pavement markings than the conventional traffic lacquer. Commercial applicator units were available on the open market, but it was necessary to develop a self-contained unit capable of carrying the applicators, heating and mixing tanks and necessary supplies for continuous operation.

The design section has also completed the modification of a smaller self-propelled traffic line marker. The basic unit was constructed by an equipment manufacturer and an additional paint gun, bead valves and boxes were added. Two of these units are now in service.

During the past year the Equipment Department has written specifications for 424 different types of equipment. Specifications are written in a manner to permit the various manufacturers to compete in bidding. Purchases of similar units are consolidated to permit volume purchasing with resultant savings. During the past fiscal year, $5,224,937.43 was expended in acquiring both additional equipment, improvements, and replacement equipment.

The Equipment Department disposed of 1,084 obsolete units by sealed bids, during the 1961-62 fiscal year, for a total of $370,000. This amounts to approximately 20 percent of the original cost of these units.

Procurement

During the 1961-62 fiscal year, the procurement section handled 29,100 requisitions and subpurchase orders amounting to $7,637,018.21. Of this amount, $4,130,000 was expended for parts, materials and supplies. In an effort to reduce overhead costs, this section has installed systems of volume purchases. The intershop catalog, showing the inventories of all critical and hard-to-obtain parts, has led to a reduction of the parts kept on hand. It has also provided flexibility in obtaining them when and where needed. A complete library of the latest manufacturer's parts catalogs and service manuals covering all Division of Highways equipment is maintained at each



A maintenance worker repairs a lamp on a freeway from one of the division's rotary brush sweeper and giraffe units.

Equipment Department shop for ready reference.

The Division of Highways, through the Bureau of Public Roads, has been granted a high priority for obtaining surplus items from the U.S. General Services Administration. Many of the shops have obtained equipment and supplies at a small percent of their original cost from this source. The Headquarters machine shop has been equipped with many machine tools acquired from the federal government at a small fraction of their first cost.

Certain employees of the Equipment Department, licensed by the Division of Industrial Safety, inspect all of the division's pressure vessels and issue certificates permitting their use if in satisfactory operational condition.

Buildings and Plants

The modernization program at Headquarters Shop, which included additional office space, a new truck shop and additional area in the automobile repair shop, was completed during the past fiscal year. An additional one-half acre of land was acquired adjacent to the spray booth and storage building for needed equipment parking area. This will allow full utilization of the repair areas rather than their use for temporary equipment storage. Volume purchasing of units for stock and off-season repair of heavy equipment necessitates an area for temporary storage of these units at Headquarters Shop.

Construction was started for new subshops at the Central Maintenance Station in District VII, Los Angeles; at Burney, District II; and at Fairfield, District X. Construction of these subshops should be completed during the 1962-63 fiscal year and will provide more economical repair operation in these areas.

The existing facilities at Shop 4, Oakland, consist of a restricted plant area which has been in service since 1920. This plant is too small for the existing workload and there is no possibility of further expansion. During the 1961-62 fiscal year, an eight-acre site was purchased in the City of San Leandro fronting on First Avenue and 1,000 feet west of Merced Avenue. Design and construction of a new shop is scheduled on this property during the 1962-63 and 1963-64 fiscal years.

At present Shop 3, Yuba City, is located in a rented building which is inadequate. Major repairs for Shop 3 are handled at Headquarters Shop in Sacramento, at considerable outlay of time and money. Land has been acquired, and design and construction of the new facility is scheduled for the 1962-63 fiscal year.

Research and Training

The research and training section investigates problems involving equipment operation and construction, the use of fuels and lubricants, and the preparation of lubrication manuals and charts. It also supervises an extensive program of training for employees of the Equipment and Maintenance Departments.

Investigations included problems on tractors, loaders, brush cutters, mowing machines, traffic stripers, and many other types.

Special training programs given during the year included automatic transmissions and mechanical features of equipment operation. Opportunities for employees to take training on their own time are continually investigated and recommended.

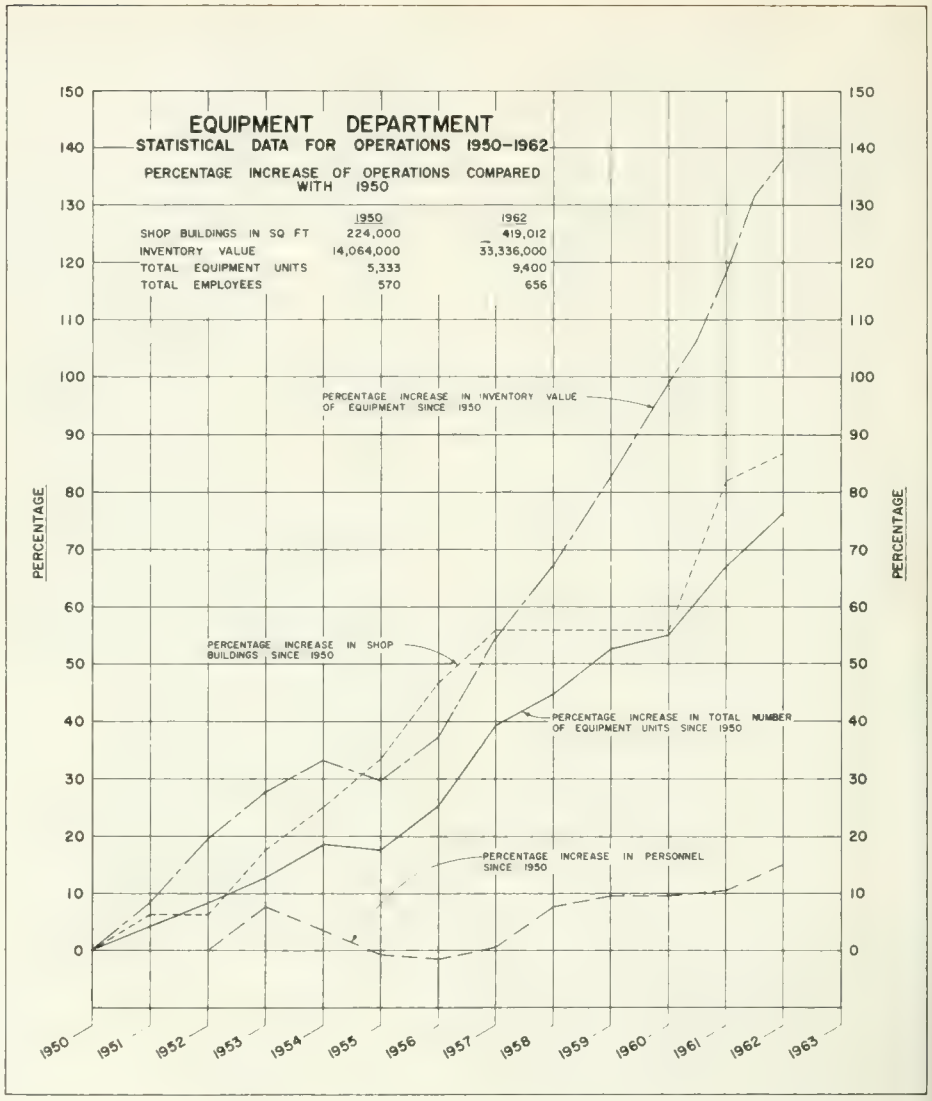
In 1953 a program of training operators of equipment in proper lubrication and preventive maintenance was established by the Equipment Department. This is a continuous program and is conducted with the co-operation of the Maintenance Department.

Statistics Section

A statistics section is maintained for the purpose of analyzing costs and adjustments of the rental rate of equipment units. Rental is charged to the operating department for the use of the various units and provides for the cost of administering, depreciation, and repair of equipment. The latest revised rental schedule was placed in effect on July 1, 1962. This system of handling the costs of equipment was established to insure that all costs are equally distributed to a particular road section or project. The Equipment Department's cost accounting system has been adopted by many other highway departments within the United States and in foreign nations.

Summary

During the past 10 years, the Equipment Department's operations have grown with the increased workload of the Division of Highways. The accompanying diagram shows this growth. During this period repair costs per vehicle per year have been reduced $92 per unit. The total cost of repairs in the last 10 years has increased 33 percent, while the total increase in equipment value for the same period has been 138 percent. Operation economies, improved purchasing methods, standardization of equipment and specification improvements have resulted in providing the operating departments with better equipment at lower cost.



EQUIPMENT DEPARTMENT SUMMARY

	June 30, 1961	*June 30, 1962*
Equipment repairs	$3,792,216.82	$4,018,794.70
Miscellaneous expense	633,685.38	645,884.61
Administration and other expense	1,048,065.57	1,047,247.95
Depreciation expense	2,819,928.05	3,361,477.72
Total expense	$8,293,895.82	$9,073,404.98
Total income	$8,222,445.00	$9,163,801.60
1961-62 Over	–	$90,396.62

Inventory: The original investment in equipment is as follows.

TRUCKS AND PASSENGER VEHICLES

All trucks, ½- to 10-ton	$13,733,822.81
Buses, jeeps and station wagons	401,532.01
Passenger automobiles	3,680,327.09

MAINTENANCE AND CONSTRUCTION EQUIPMENT

Motor graders	$4,207,835.90
Rotary snowplows (truck mounted)	1,546,481.91
Rotary snowplows (motor grader mounted)	131,649.71
Shovels, power	409,501.28
Loaders	2,177,124.60
Tractors	752,670.78
Snowplows, push	696,215.45
Compressors	340,127.70
Miscellaneous – other equipment, rollers, mixers, trailers, pumps, drills, mowers, etc.	5,258,710.89
Total	$33,336,000.13

Administration

The Assistant State Highway Engineer, Administration, exercises control over the following: office engineer; federal-aid secondary and county co-operative projects; city and co-operative projects; service and supply; management analysis; and systems research

OFFICE ENGINEER

The office engineer is responsible for a wide range of administrative activities chief of which are: preparation, review and processing of plans, estimates, and bid and contract documents; budget and expenditure control; administration of federal funds; industry contacts; bidder prequalification records; reports and statistics; mail and general files.

Budget and Project Control

Engineering control of the state highway budget involves procedures to insure that provisions and amounts specified in the budget are observed; preparation and processing of contract documents; preparation of final documents submitted to the California Highway Commission; issuance of work orders; and maintenance of construction records.

Taylor Boulevard, a new Contra Costa County freeway near Concord, constructed under the federal-aid secondary and F.A.S. urban extension programs.



During the year, 419 financial votes were prepared for commission action; 565 projects were advertised for bids with an estimated cost of $332,902,600; and 543 projects were determined to be satisfactory for contract award.

In addition to the major contract work, the financing of 290 minor and informal contracts, with a total value of $517,300, was cleared.

Plans and Estimates

This unit is responsible for the review and co-ordination of plans and specifications to assure they are in agreement before projects are advertised for bids. A backlog of reviewed projects is maintained so that all funds may be obligated without delay when they become available. Estimates of cost on all projects are reviewed at various stages before the opening of bids and, whenever necessary, the estimates are adjusted to bring them into line with prevailing construction costs. Materials information brochures are prepared and made available to bidders.

Draftsmen assigned to this unit prepare maps for all projects, prepare summaries of bids received, and draft sketches. They also perform work for other state agencies. They prepare the map included in the annual report supplement.

The recently adopted project record-consolidated status estimate form used in conjunction with the progress and payment of all regularly advertised contracts is also prepared by this unit. Monthly estimates, varying during the year from 297 to 391, depending on the number of contracts under way, are checked and processed, as are contract change orders. On June 30, 1962, there were 391 contracts valued at $666,559,200 under way.

Specifications

Specifications were prepared for 570 projects during the year. Specifications also were prepared for future projects to expedite advertising for bids when funds are available.

The Division of Highways Standard Specifications for highway projects, placed in use in January 1960, are being revised to include late improvements in construction methods, ma-

terials and equipment. The revised specifications are expected to go into effect early in 1963.

Reports and Statistics

The reports and statistics unit maintains statistical records of highway construction contracts awarded, which numbered 543 during this fiscal year. Records are kept for preparation of the quarterly California Highway Construction Cost Index, and forecasting future materials requirements. Weekly and monthly reports for management purposes also are prepared showing the value of budgeted and nonbudgeted programs, and of other projects for which bids are received. This unit also compiles the Statistical Supplement to this report.

The contracts placed underway during 1961-62 covered 1,571 centerline miles of state highway, including resurfacing. The Department of Public Works awarded contracts for construction on 165 miles of federal-aid secondary county roads.

Prequalification of Contractors

Prequalification is required of all contractors who bid on state highway projects estimated to cost more than $50,000. The prequalification rating, representing the maximum bidding capacity for each of the several types of work which a bidder is capable of undertaking, is established from a review of each contractor's statement of experience and financial condition.

The total number of contractors prequalified to bid on all types of state highway construction decreased from 913 on July 1, 1961, to 860 on July 1, 1962. This decrease is primarily due to the discontinuance, beginning January 1, 1961, of prequalification requirements for bidders on projects estimated to cost $50,000 or less.

The combined bidding capacity of the 860 prequalified contractors is $2,617,750,000. This is $182,310,000 more than a year ago.

The number of contractors prequalified by the Division of Highways on June 30, 1962, arranged by the several brackets of bid ratings, was as follows:

Rating	*Number of contractors*
$10,000,000 and over	81
5,000,000 to $10,000,000	144
2,500,000 to 5,000,000	232
1,500,000 to 2,500,000	306
1,000,000 to 1,500,000	373
500,000 to 1,000,000	522
250,000 to 500,000	688
100,000 to 250,000	823
50,000 to 100,000	860

Bids and Bidders

The average number of bidders per project during the year was 5.4, practically unchanged from last year's level of 5.5. The highest monthly average of 6.8 was in December 1961. The low of 4.3 was in June 1962. The contracts awarded during the fiscal year have been arranged in eight value ranges as shown in the accompanying "Contract Value Range" table.

Construction Cost Index

The California Highway Construction Cost Index reflects changes in

STREET AND HIGHWAY MILEAGES

Highway and street mileages, with which the Division of Highways is directly or indirectly concerned, are shown below:

	Miles	*Miles*
Total state highway system (including portions of city streets and FAS system)		16,355
Highways proposed for construction where roads do not exist		2,226
Constructed state highways		14,128
Federal-aid system		
Primary rural (12-31-61)	7,980	
Primary urban (12-31-61)	1,502	
Total		9,482
Federal-aid interstate system (included in above)		2,178
Federal-aid secondary system (6-30-62)		
On state highways	3,922	
On county roads	8,215	
Total		12,137
County primary road system (6-30-62)	24,595	
Other county roads (6-30-62)	45,433	
Total county maintained system		70,028
City streets (estimated 12-31-61)		31,599
City streets on state highway system		1,734

STATE HIGHWAY MILEAGE BY SURFACE TYPE

TYPE	NORTH			SOUTH			TOTALS		
	Outside cities	Inside cities	Total	Outside cities	Inside cities	Total	Outside cities	Inside cities	Grand Total
Concrete	512.131	164.537	676.668	542.612	367.875	910.487	1,054.743	532.412	1,587.155
High bituminous	4,231.078	499.511	4,730.589	3,466.042	603.527	4,069.569	7,697.120	1,103.038	8,800.158
Low bituminous	1,404.340	29.640	1,433.980	839.131	8.427	847.558	2,243.471	38.067	2,281.538
Oiled earth, gravel	594.650	.714	595.364	641.352	4.329	645.681	1,236.002	5.043	1,241.045
Graded and drained earth	37.737		37.737	23.162		23.162	60.899		60.899
Bridges	71.038	32.673	103.711	31.263	22.719	53.982	102.301	55.392	157.693
Totals, constructed road	6,850.974	727.075	7,578.049	5,543.562	1,006.877	6,550.439	12,394.536	1,733.952	14,128.488
Unconstructed road	1,152.684	142.463	1,295.147	700.041	231.186	931.227	1,852.725	373.649	2,226.374
Total highway system	8,003.658	869.538	8,873.196	6,243.603	1,238.063	7,481.666	14,247.261	2,107.601	16,354.862

CONTRACTS BY TYPE

This tabulation gives the number of contracts with mileage by types awarded during the 1961-62 fiscal year.

Number of contracts		*Centerline miles*
35	Portland cement concrete	140.7
179	Asphalt concrete	1,191.8
3	Road mix	3.9
15	Seal coat	245.0
1	Grading	0.2
68	Traffic signals and lights	–
39	Bridges	–
114	Miscellaneous	–
454	Total	1,571.6

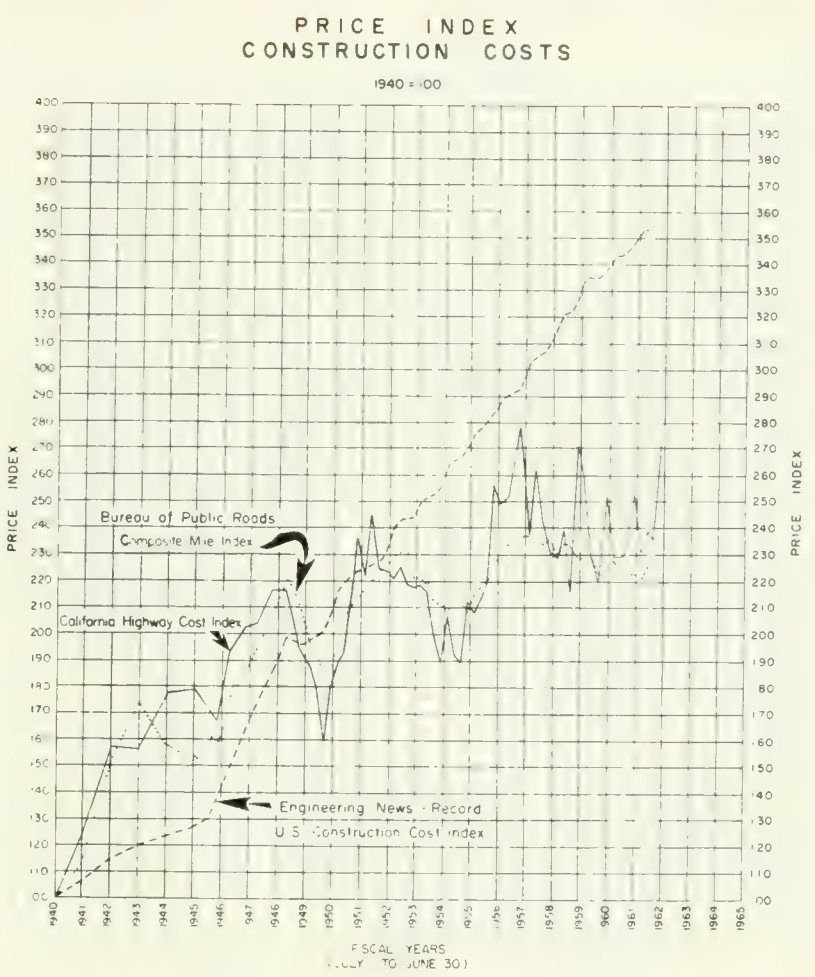
NOT ON STATE HIGHWAY SYSTEM

County Roads—Federal-aid Secondary

Number of contracts		*Centerline miles*
40	Asphalt concrete	127.6
4	Road mix	11.7
3	Seal coat	11.8
2	Grading	13.8
8	Bridges	–
27	Miscellaneous	–
84	Total	164.9

STATE PARKS, ETC.

Number of contracts		*Centerline miles*
5	Miscellaneous	–



highway construction costs. The index is founded upon weighted average contract prices for seven principal construction items in place, all referred to the base year of 1940 with a value of 100.

The fiscal year began with an index value of 230.5 in the third quarter of 1961, increased to 238.5 the following quarter and dropped slightly to 235.7 during the first quarter of 1962, maintaining the trend of stable prices which started in 1959.

The index, however, rose sharply during the second quarter of 1962 to 271.1. This was partly due to increases in materials and wages in the construction industry which previously had been absorbed by stronger competition and higher productivity. Another reason for the higher index was a project on U.S. 40 (I-80) in the Sierra Nevada Mountains, where difficult construction conditions tend to increase costs, which was bid at higher-than-average prices for roadway excavation and concrete structures.

The accompanying graph shows a comparison between the California Index, the Bureau of Public Roads Index and the Engineering News-Record Construction Cost Index. The base and the weighting structure of the BPR Index recently have been changed. The index is shown on the composite-mile basis for the years 1940 through 1961 and converted to the new basis from the first quarter of 1962. The latter two indexes are based on nationwide construction costs and do not reflect the pronounced rises and falls to be found in an index where local conditions are a controlling factor, as in the California Index.

Federal Aid

A total of $286,631,017 in federal-aid funds was apportioned to California for 1962-63 under the Federal-aid Highway Acts of 1958 and 1960. This included $22,247,521 for primary highways, $10,532,114 for secondary routes, $25,004,182 for urban routes, and $228,847,200 for interstate highways. The federal matching ratio on primary, secondary, and urban projects is 59.52 percent. On interstate projects the federal ratio is 91.59 percent.

At the start of the fiscal year, construction was in progress on 99 contracts with a total cost of approximately $459,910,000, some $360,710,000 of this amount financed from federal-aid primary, urban, and interstate funds.

Seventy construction contracts involving $13,182,000 of primary funds, $9,475,000 of urban funds, and $138,502,000 of interstate funds, were completed during 1961-62. These amounts, together with the required state

CONTRACT VALUE RANGE

	Number of projects	*Percent of total*	*Value of projects*	*Percent of total*
Under $50,000	236	43.5	$4,943,900	1.6
$50,000 to $100,000	70	12.9	5,079,500	1.7
100,000 to 250,000	98	18.0	16,802,800	5.5
250,000 to 500,000	46	8.5	16,394,400	5.4
500,000 to 1,000,000	27	5.0	18,638,700	6.1
1,000,000 to 2,500,000	28	5.1	43,880,500	14.3
2,500,000 to 5,000,000	22	4.1	85,455,200	27.9
Over $5,000,000	16	2.9	114,662,100	37.5
	543	100.0	$305,857,100	100.0

matching funds, bring the combined total cost of such improvements during the year to approximately $199,186,000.

Seventy-six contracts totaling $223,525,000 were awarded, of which $171,630,000 were primary, urban and interstate federal-aid funds. Fifty-seven of these contracts provide for improvements on the national system of interstate highways and cost $146,342,000. The federal share amounts to $130,105,000.

Right-of-way project agreements with the Bureau of Public Roads increased interstate federal-aid funds obligated for participation in right-of-way acquisition costs by $59,490,000, making a new total of $357,811,000.

Industry Contract

The Industry Contract Section obtains prevailing wage contract data from contractor and labor organizations; collects information for the establishment of equipment rental rates for use on force account work; represents the Division of Highways at hearings of the California Public Utilities Commission on dump truck rental and asphalt hauling rates; and processes minor contracts, right-of-way clearance contracts, informal bid and emergency contracts, and service contracts.

Service Contracts

Nearly 5,000 service contracts were processed involving a total expenditure of $7,000,000.

This type of contract is used for renting equipment and obtaining a wide variety of services. Its use is confined to work not covered by the State Contract Act and not adaptable to minor contracts, right-of-way clearance contracts and other prescribed procedures.

The principal use of service contracts, involving an expenditure of nearly $2,100,000, was for the rental of equipment for highway maintenance, for highway construction by honor camps, and for occasional day-labor highway construction projects.

Minor Contracts

Small projects not exceeding $5,000 are handled by the districts. A total of 290 minor contracts valued at $517,000 was awarded during the fiscal year. The average amount per contract was approximately $1,780.

Standard Agreements

Certain types of personal services are obtained under standard agreement. During the fiscal year 90 standard agreements were processed covering such services as appraisers and expert witnesses in right-of-way matters, and professional consultants in unusual design and economic investigations.

Right-of-way Clearance Contracts

As in past years, contracts were awarded to clear rights-of-way in advance of construction. Some 897 contracts totaling $2,400,000 were awarded for the demolition of buildings; 50 contracts totaling $292,500 were awarded for altering and moving buildings, relocating irrigation systems and fences, and drilling wells.

COUNTY AND CO-OPERATIVE PROJECTS

The Federal Secondary Roads Section handles liaison between the U.S. Bureau of Public Roads and the counties concerning all Federal-aid Secondary projects. This unit also performs administrative and engineering functions concerning county and city construction projects on urban extensions of the FAS system, and flood damage repair projects on the local road and street systems. It also keeps county road mileage records used by the State Controller to apportion funds to the counties from the Highway Users Tax Fund. All of these functions are performed with the assistance and co-operation of the City and County Projects Sections in the districts and the Bridge Department.

Administrative and engineering functions performed by the Headquarters Office unit under direction of the engineer of federal secondary roads were combined with those of the city and co-operative projects section on July 2, 1962. The principal staff position in the combined operation carries the title of city and county projects engineer. Henceforth the report for these two units will be combined under the heading of city and county projects.

The FAS Program

The Federal-aid Highway Act of 1944 initiated a continuing program of construction on a nationwide system of principal secondary and feeder roads. As of June 30, 1962, there were 12,137 miles of federal-aid secondary routes in California, including 8,216 miles on county roads and their urban extensions. During the year, there was a total net increase of 122 miles in the system, 44 miles of which were local roads and city streets.

Fifty-eight county federal-aid secondary contracts were awarded during the same period at a total cost of $14,643,100. These funds covered construction on 171.8 miles of road and 29 bridges.

Federal funds for secondary highways, authorized for the 1962-63 fiscal year, were apportioned to the State on October 10, 1961. California received $10,532,114, of which 87½ percent or $9,215,600 was reapportioned to



Another example of a new federal-aid secondary project, this one on Limonite Avenue in Riverside County.

the counties in accordance with law. The Division of Highways retains 11 percent of the total allocation for construction on FAS state highways and 1½ percent for planning purposes.

A total of $4,215,828 was provided from the State Highway Fund in accordance with Section 2210.5 of the Streets and Highways Code to pay counties' share of the construction projects up to a maximum of $100,000 per county.

The Urban Extension Program

A program authorized by the 1959 Legislature (Section 143.3 of the Streets and Highways Code) provides state highway funds on a matching basis for improving urban extensions of the Federal-aid Secondary System that are major city or county arterials integrated with the state freeway network and improvements in the contiguous rural area. Projects are approved on the basis of anticipated traffic volumes which would qualify the proposed sections for improvement to multilane divided status.

Of the first five projects approved for allocations from the 1960-61 budget, four have been successfully completed. The fifth is nearing completion.

All 10 projects approved for the 1961-62 fiscal year were placed under contract before the end of that year. Three of them have been completed. The total cost of these 10 projects is approximately $3,000,000. State highway funds totaling $1,466,900 have been obligated toward their accomplishment.

Allocations totaling $1,414,500 were made by the Highway Commission for fiscal year 1962-63 to pay one-half the cost of an additional five projects. Applications for allocations totaling $1,045,500 are on hand for eight other projects to be financed from the 1963-64 budget.

Flood Damage Repair Program

Except for two projects still to be completed under the Flood Relief Law of 1956, there has been total completion of the flood damage repair program financed under the Budget Act of 1958. Good progress has been made in repairing the 1960 storm damage to local roads and streets under the initial program financed under the permanent Emergency Flood Relief Law enacted by the 1959 Legislature. At the end of the fiscal year, there was only one project not yet ready for contract.

During November of 1961, the northern three counties on the west coast of California suffered intense storms which caused flooding and damage to roads and bridges. In February of 1962, Los Angeles and Ven-

tura Counties were hard hit by heavy rains which caused flooding and brought down mud and debris from burned-off hills upon residential communities in the foothill canyons. Much of the latter damage was quickly repaired and through a "state of disaster" proclamation by the Governor, federal aid was made available under Public Law 875. State funds to activate the Emergency Flood Relief Law were made available by the Legislature under item 13.6 of the Budget Act of 1962.

By the end of the fiscal year, the three northern counties and one city in the south had applied for state aid with qualifying damage totaling over $1,300,000. In accordance with the statutes, employees of the division investigated the damage and filed reports for transmittal to the Department of Finance. Through an agreement with the California Disaster Office, Division of Highways engineers also investigated and filed reports on 24 local agency applications for Public Law 875 funds to repair road and street damage.

County-maintained Roads

The total county-maintained road mileage on June 30, 1962, stood at 70,027.69. The annual certification issued to the State Controller in accordance with Section 2121 of the Streets and Highways Code showed a net increase of 189.20 miles.

County primary road system changes approved by the department resulted in a net increase of 286.33 miles, bringing the total to 24,594.70.

CITY AND CO-OPERATIVE PROJECTS

The primary function of the city and co-operative projects engineer is the administration of the gasoline tax funds allocated for use on city streets.

The Streets and Highways Code provides that ⅛-cent tax per gallon shall be allocated annually by the California Highway Commission from the State Highway Fund for expenditures on city streets, on the basis of each city's percentage of the total population of all cities in the state.

The code also provides for the annual allocation of amounts ranging from $1,000 to $20,000 to each city for engineering costs and administrative expenses in respect to city streets. A modification of the code made in 1961 allows cities of less than 10,000 population to use some of these funds for construction.

New Manual

A new manual, *City and Cooperative Projects Manual of Instruction*, was developed early in the year, and distributed to the cities and others involved in city gas tax allocations. This manual sets forth policies and procedures for budgeting and expenditure of the gas tax funds allocated to the cities.

Use of the manual along with simplified forms and methods recently put into effect has brought a better understanding between the cities and the division and reduced the time required to process city projects.

Funds Budgeted

A total of $41,621,270 was budgeted for city projects during the fiscal year; including $25,193,707 for surveys, plans and construction; $6,063,530 for rights of way; and $10,364,033 for maintenance. (See accompanying tabulation).

Funds allocated for engineering and administration amounted to $1,197,033.

Major City Street Systems

Each city council is required by law to select a system of major city streets subject to approval of the Department of Public Works. Three-fifths of the state-allocated (⅜-cent) funds are spent for the construction of streets included in these systems.

Master plans being developed by many cities and counties provide a good basis for the selection of these major streets by city councils. During this past year, many cities updated their major city street systems.

Two-fifths of the state-allocated (⅛-cent) funds may be expended for maintenance or for construction.

During the year, 501 sets of plans, specifications and estimates were reviewed and approved for construction. These plans provided for the improvement of 170 miles of streets at an estimated cost of $24,431,553.

Population Figures, New Cities

Populations of cities, upon which apportionment of state-allocated funds are based, are determined by the U.S. census or special census figures; these are modified periodically by estimates of the State Department of Finance, annexations and incorporations.

The total estimated population of the 377 incorporated cities at the end of the fiscal year was 11,978,475, or approximately 70 percent of the estimated 17,094,000 total state population.

The population in cities increased 534,670 during the fiscal year. This is 5 percent over the June 30, 1961, estimate.

There were 1,131 city annexations during the fiscal year. Five new cities were formed by incorporations. The new cities, with dates of incorporation and estimated population, are: Bell Gardens, Los Angeles County, August 1, 1961, 27,650; Hidden Hills, Los Angeles County, October 19, 1961, 1,653; Pleasant Hill, Contra Costa County, November 14, 1961, 26,328; Brisbane, San Mateo County, November 27, 1961, 4,476; and Villa Park, Orange County, January 11, 1962, 1,368.

Funds Available to Cities

State-allocated (⅛ cent) funds available to cities for budgeting during this fiscal year:

Unbudgeted funds in city treasuries and in the State Highway Fund, June 30, 1961	$9,694,337.02
Apportionments during the fiscal year	34,948,775.92
Savings on completed projects and canceled projects and interest and rental receipt accruals	7,905,810.29
Total available for budgeting during the fiscal year	$52,548,923.23
Actual amount budgeted	41,621,270.94
Carryover for budgeting in the 1962-63 fiscal year	$10,927,652.29

SERVICE AND SUPPLY

The Service and Supply Department performs many necessary functions of the division not directly connected with the design construction and maintenance of highways.

Service

Reproduction. Through the use of new procedures this section continued to provide increased reproduction services at a low cost. The Duplicating Unit ran 80,827 masters for a record total of 15,388,172 impressions. This is a 14 percent increase over last year.

Photography. An increase of 43 percent (1,684 compared to 1,175) in orders processed was made possible by new techniques. The need for aerial and color photos has increased greatly.

Records Management. The Sacramento Record Center now has 18,386 cubic feet of records in storage, an increase of 12 percent over last year. There were 18,366 references made to these records during the year. This service will be initiated in our South Warehouse during the next year.

Business and Building Services, Property and Building Management. These comprehensive services made possible the orderly "housekeeping" of Headquarters. This section has been active in expediting the move into the new annex.

Salvage. Another service rendered in co-operation with the supply function is the recovery and utilization of salvage and excess materials from construction and maintenance operations.

Supply

Total purchases processed by Service and Supply for the Division of Highways totaled over $15.4 million, including warehouse shipments.

Typical of the size of the supply operation was the procurement of nearly four million survey stakes, lath, hubs and ginnies for the field forces. Another item that is being used in greater and greater amounts is glass spheres (beads) used in paint to give it reflective qualities. The order this year was increased to almost one million pounds.



Freeway signs are loaded on a truck at the Los Angeles warehouse.

More than 12,000 requisitions to the Purchasing Division of the Department of Finance were processed.

Warehouse distribution operations continued to increase even though inventories were reduced. When possible the warehouses are bypassed by having shipments sent direct from suppliers to the point of use. This saves unnecessary handling and warehousing. Total purchases were $5.67 million (up 8.1 percent from last year). Total disbursements were $5.73 million (up 15.2 percent). Total inventories were $2.30 million (down 2.4 percent). The ratio of disbursements to inventories was 2.5 to 1, which is the most favorable ever experienced. A total of 34,539 requisitions covering 117,369 items were filled. The distribution of these materials entailed making 13,410 shipments.

Many U.S. government surplus items were obtained at a considerable saving over normal acquisition methods.

The sign program has been expanding rapidly, with the warehouses handling 66,361 signs in the past year.

The budget for nonrental equipment was $1,200,000. Through cooperation by the districts and other departments, expenditures were held to about $1,077,000. The nonrental inventory as of June 30, 1962, was $14.9 million, up 7.3 percent from the previous year.

Orders to the State Printing Plant are being combined and standardized for efficient handling. As a result, the number of printing orders has not increased over last year in spite of an increase in quantity of material ordered. Printing costs can be lowered by a judicious grouping of items.

The catalog of warehouse items is being constantly revised. A new method of preparing catalog copy is being used which will result in faster listing of new items.

Service and Supply Headquarters Office has assumed the responsibility for the payment of all freight bills, to promote efficiency in the processing of these documents.

MANAGEMENT ANALYSIS

The purpose of this section is to make studies and recommendations and provide advisory services on administrative and management problems throughout the division, and to assist in carrying on a divisionwide records management program.

Several major steps were taken toward improving procurement and warehousing operations by reducing current inventories and maintaining future inventories at minimum levels consistent with need, resulting from a specific study in this area.

As the result of another study, improvements were made in the method of submitting division needs for nonrental equipment. This has facilitated the review and modification of needs. A further improvement in the revised nonrental equipment system was developed and tried on a pilot basis.

Two comprehensive record usage studies were made for two districts. The recommendations are being implemented and are resulting in: reduced cost of filing operation; elimination of duplicate records; elimination of obsolete material; reduction in purchase of new filing equipment; saving of office space; and a uniform filing procedure. Reduction of prime office space for District VII will result from changing the southern record warehouse to a file record center operation.

The field review of filing needs resulted in a dollar savings of more than $19,500 for the 1962-63 fiscal year. Previous usage studies and periodic consultation with recordholders caused movement of 5,900 cubic feet to record centers and destruction of 5,600 cubic feet during 1961.

Assistance given in the design of forms resulted in four division memorandum forms being eliminated.

SYSTEMS RESEARCH

The first full year of operation of the systems research engineer has been mainly devoted to the study and analysis of problems in the fields of engineering costs and productivity. Staff support has been provided by the Management Analysis Section and the Project Control Unit of the Office Engineers Department.

A statewide study of engineering costs was made, especially in those areas of engineering methods and activities which were most significant in developing good performance ratios and those which produced poor performance ratios. Considerable effort was directed at developing a greater sense of cost consciousness in the attitudes of the personnel engaged in engineering activities, as well as those in nonengineering or "support" positions.

A second major study was initiated to develop productivity indices, based on the actual accomplishments of the districts and the Bridge Department during the period July 1, 1955, through June 30, 1961, which could be applied to planning program schedules to project overall staffing needs and corollary requirements through 1970-71. Further refinements of the indices are being studied which will eventually result in a workable staffing guide for use by all offices of the division to determine future needs.

This study, which is still underway, has already provided management with a useful tool in forecasting personnel requirements in relationship to program goals. When the basic procedures have been perfected and programed for electronic data processing the division should be able to forecast and anticipate adjustments in its working force in each district resulting from changes in program emphasis or size.

Close co-ordination has been maintained with the Accounting Department in converting the Division of Highways accounting to electronic data processing for cost analysis purposes. In order to make the accounting information more helpful to management throughout the division, activity codes were more accurately defined, additional needed codes determined and unnecessary ones discarded. With the installation of the latest in electronic data processing equipment, it is expected that detailed cost information resulting from the conversion will be available within the next (1962-63) fiscal year and should furnish valuable data to management to further aid in the establishment of productivity standards and control of engineering costs.

The systems research engineer also headed staff liaison for the budget review committee of the division in the preparation and review of the operating budget for the Headquarters units for the current fiscal year period.

. Planning

● *The Assistant State Highway Engineer, Planning, is in charge of advance planning, programs and budgets, design, traffic, and highway planning survey*

ADVANCE PLANNING

The advance planning engineer is in charge of the Advance Planning and the Photogrammetric Units.

The Advance Planning Section is responsible for processing project reports, co-ordinating route adoptions and freeway declaration procedures, processing freeway agreements, and co-ordinating the Division of Highways planning work with that of other state, federal, or local agencies.

Project Reports

A project report covers the engineering investigation and analysis of a specific project. This report sets forth need and type of the planned highway improvement and how it should be accomplished.

Project reports are required for all proposed improvements. They constitute a control mechanism in planning and budgeting, and provide information for basic design features. They are prepared in the districts.

The reports are reviewed at the Sacramento headquarters where analysis by other departments is co-ordinated by the Advance Planning Section after field review. This analysis insures an orderly development of surveys and plans.

Aerial mapping is being used more and more to evaluate topographic controls and expedite the preparation of project reports.

Project reports for 281 proposed projects were processed during the year, 177 of which were major projects.

Freeway Routes

The development of an integrated system of freeways, one of the most important phases of modern highway planning, has been emphasized in California for many years. It involves consideration of community values and potential land uses, as well as traffic needs and benefits.

The Division of Highways informs all local authorities of the initiation of freeway route studies and of the general features of proposed freeway units as the studies progress. When sufficient information has been developed on a specific freeway project, a well-publicized public hearing is held in the general area to present the results of the study to local officials and the interested public and to learn the local reaction to the project plus any information which may be pertinent to the routing. The current commission procedural policy, which is contained in Subchapter 4 of the California Administrative Code under which the Division of Highways operates in freeway route location matters, is included in the statistical supplement of the Annual Report.

Transcripts of proceedings of public hearings, together with reports on the results of conferences are made available to the Highway Commission for consideration in the determination of freeway routings.

During the 1961-62 fiscal year, the district staffs of the Division of Highways held 58 of these formal public hearings to discuss proposed freeway routings. A number of conferences with city and county officials and their technical staffs were also held, as were several hundred preliminary informational meetings and map displays. The California Highway Commission itself also held 11 public hear-

Construction is continuing on U.S. 101 freeway through the San Diego Metropolitan area. This view shows the freeway route looking southward toward National City from the San Diego downtown business district. San Diego Bay at right.



ings during the year, 7 at the request of the local authorities and 4 on its own initiative. The public hearings held my both the Highway Commission and the Division of Highways are listed in the statistical portion of the Annual Report.

The California Highway Commission had under consideration during the year some 76 freeway projects and adopted routings on 65 of them. These adoptions increased the freeway mileage 594 miles, making a new statewide total of 6,203 miles of declared freeway as of June 30, 1962.

Freeway Agreements

Close co-operation between the State and cities and counties resulted in working out and concluding 207 freeway agreements during the year. In some cases, original agreements were replaced by supplemental agreements which incorporated improved design standards or provided for changes in traffic patterns or local planning.

Interstate Highway System

Advance planning is also responsible for obtaining the approval of the U.S. Bureau of Public Roads on the final locations of all routes on the interstate highway system. This is done for each interstate section after adoption by the California Highway Commission. At the end of the year, the locations for approximately 1,936 miles, about 89 percent of the interstate system in California, had been approved. Another 170 miles were being processed for submission to the bureau. The total mileage approved or under consideration at the end of the fiscal year is, therefore, about 96 percent of the total authorized interstate system in the State.



Surcharge fill is being placed across coastal lagoons north of San Diego for the future relocation of U.S. 101 (Interstate 5). This view is southward across Batiquitos Lagoon, toward Leucadia and Encinitas.

National Forest Highways

The Division of Highways acts jointly with the U.S. Bureau of Public Roads and the U.S. Forest Service in an annual improvement program on California roads designated as forest highway routes. The forest highway network in California covers approximately 2,537 miles, about 75 percent of which is on State highway routes.

The California apportionment of forest highway funds for the 1961-62 fiscal year was $4,726,004. Including funds remaining from previous apportionments, the distribution of forest highway money in the State as agreed upon by the three agencies were as follows: projects on state highways, $5,360,000; projects on county roads, $200,000; system surveys, $250,000.

The Bureau of Public Roads plans, designs, advertises and supervises the construction of federally financed forest highway projects. For projects on state highways, the Division of Highways works with the bureau in the planning and design phases and also obtains the required rights-of-way, including clearance of utilities and options on material sites.

PHOTOGRAMMETRIC MAPPING AND AERIAL PHOTOGRAPHY

Aerial photography has become an important aid in advanced planning, design, right-of-way, and traffic studies, and is also used to some extent in other facets of the highway program. The need for up-to-date aerial photography and associated reproductions now constitutes about 24 percent of all photogrammetric costs, compared to 15 percent reported in previous years.

Photogrammetric mapping, which makes up the other 79 percent of all photogrammetric costs, is frequently used during the advanced planning phase on the study of possible alternate routes, and the location and design of adopted routes. Most of this work was done by contract, although a portion of it was performed by the photogrammetry unit.

The accompanying table is a resume of expenditures for contracts completed during the fiscal year.

Developments

Photogrammetric cross sections have been taken on some construction projects for the computation of earthwork excavation quantities. The cross-section data are automatically recorded on punch cards by means of an elec-

	Contracts	*Highway strip miles*	*Contract amount*
Contour mapping projects for design	40	319	$392,894
Contour mapping projects for reconnaissance	5	57	33,231
Stereoplotter rental contracts	13	–	60,387
(Compilation for design)	–	106	–
(Compilation for reconnaissance)	–	63	–
Aerial photography contracts	18	–	50,540
Aerial photography contracts (blanket)	10	–	105,043
Total			$642,095

tronic attachment to a stereoscopic plotting instrument. The procedure has been used to advantage on several types of construction problems.

For example, a large slide occurring during construction of one project ultimately required a major design and construction change. Immediately after the slide, aerial photography was taken to obtain a record of the ground for photogrammetric cross-sectioning. As the reconstruction progressed, more photographic missions were flown for cross sections which were used as a basis for computation of progress pay quantities.

In another instance, a material site was located in gold dredger tailings. Aerial photography was taken for photogrammetric cross sections of the undisturbed ground. This particular site was characterized by successive rows of rock ridges about 20 feet high, making it very difficult to cross-section by field methods. Upon removal of the material, a second flight is planned for cross sections for computation of total excavation for final payment.

A third instance involved a major construction project in timbered, mountainous terrain. The right-of-way had been cleared under a separate contract one year in advance of construction. Because of adverse weather conditions field surveys were delayed up to the time of the construction contract. In order to allow construction to proceed on schedule an aerial photographic record of the undisturbed ground was taken for the cross sections. The excavation quantities devolped from the cross sections will be used for final payment.

Precision aerial photography of the terrain prior to construction provides a permanent record which can be referred to any time after construction has commenced. For this purpose it is necessary to premark or target the staked centerline, or its equivalent, before the photography is taken to insure positive identification of the line.

Map Checking

About two-thirds of the total mapping mileage obtained by photogrammetric contract is reviewed photogrammetrically. This is an established service which provides advanced information to the districts as a guide for performing accuracy surveys by field methods.

Geodetic Distance Measurement

The photogrammetric unit continued to operate the geodimeter party as a service to districts requiring precise surveys. The following tabulation is a resume of the operations by this party:



A mileage marker for aerial surveillance is painted on U.S. 40 near Davis.

Observing nights	126
Number of observations	1,293
Number of setups	576
Average number of observations per setup	2.2
Average number of observations per night	10.3
Total miles observed	643.0
Average distance observed (miles)	0.5

Because of the demand for geodimeter surveys, several districts were encouraged to obtain their own equipment. The division now has a total of eight Model 4 geodimeters, seven of which are located in district offices and one in headquarters.

PROGRAMS AND BUDGETS

The Programs and Budgets Section makes projections on the availability of funds for highway purposes, establishes target figures to be used in planning, develops the statewide long-range planning program in co-operation with Planning Survey, prepares budget recommendations for consideration by the California Highway Commission, maintains a constant check on the funds available for highway purposes in a fiscal year budget, recommends action on unbudgeted or minor improvement projects, and administers the annual buildings and plants program.

Budget and Revenue

Division of Highways funds are derived from state and federal sources. State sources, which comprise the major portion, are the gasoline tax, the use fuel tax, motor vehicle fees, and the transportation tax. Federal apportionments for right-of-way acquisition and construction on federal-aid projects during the fiscal year amounted to approximately $274,000,000, or about 42 percent of the total revenue.

The division's revenues closely accord with the volume and type of highway traffic. Traffic records throughout the State are used as a guide in estimating probable revenues for planning purposes. For budgeting, estimates of probable revenues are determined after consultation with other agencies with functions related to state highway income, particularly the Departments of Finance and Motor Vehicles, and the Board of Equalization.

Planning Program

Planning programs for the eight-year period from July 1, 1963, through June 30, 1971, were developed for the 11 state highway districts.

Each district prepared and submitted a program for the period. These programs were reviewed by all Headquarters departments and modified to provide uniformity and continuity on a statewide basis.

The planning programs as modified and adjusted were presented to the California Highway Commission for their review.

These planning programs are the first under the new allocation and expenditure provisions of the statutes enacted at the 1961 session of the Legislature.

Expediting and Co-ordinating

Continuation of the expediting and co-ordinating function has resulted in a close liaison between the districts and Headquarters departments. Frequent review of the status of the various proposed construction projects helps to eliminate delays in completion of plans, right-of-way acquisition and utility relocations.

Statistical records are being maintained to show the complete status of each highway construction project from initial planning studies to the call for bids.

Buildings and Plants

During the fiscal year, the addition to the headquarters annex building was completed. Construction of an annex building at the district office in San Francisco was begun. Maintenance stations at Willow Creek, Weitchpec, Hot Creek, Alemany, Mendota, Barstow, Dry Creek, Riverside, Sonora Junction, Long Barn, Coulterville and Groveland were constructed or enlarged.

Plans were being developed for maintenance stations at Forest Glen, Elk Grove, Nevada City, Kyburz, Petaluma, Wrightwood, Dawson Saddle, District VII Laboratory, Death Valley Junction, McGee Creek and San Diego.



Each year the California State Chamber of Commerce sponsors "grass roots meetings" on highway planning. At the Salinas session, shown here, A. H. Clark of Soledad, Central Coast Chairman for the State Chamber Highway Committee, is displaying a highway planning map as Programs and Budgets Engineer E. J. L. Peterson (standing, left) explains Division of Highways financial projections.

DESIGN

The work of the Design Department includes geometric design; structural design of the roadbed; contract plan review; research and special studies; drainage and co-operative agreements; and erosion control and roadside development.

Geometric Design

The Geometric Design Unit processed 580 interchange and intersection designs during the year, including 16 designs for bus stops, weigh stations and safety rest areas. The exhibit maps for 207 freeway agreements were reviewed and a total of 45 reports involving requests for new connections or separations on freeways were processed for presentation to the California Highway Commission. A total of 577 bridge designs were reviewed with respect to geometric design features.



Looking east along the newly opened Ventura Freeway extension from above the interchange with the Hollywood Freeway in North Hollywood.

Structural Design of the Roadbed

All proposed projects are reviewed with the primary objective of providing for the structural requirements of the roadway and insuring the most effective and economical use of materials. Reviews are performed at various stages of project design and include the structural typical sections, 185 of which were submitted during the fiscal year; materials reports; preliminary reports; special provisions and contract changes. Justification of the pavement type selected for each major project is documented.

Close liaison is maintained with the districts and other headquarters departments regarding design details for specific conditions such as foundation and slope stabilization, embankment protection, subdrainage, materials sources and specifications.

Periodic observations are made of the service performance of pavements and related design features in order to obtain factual data upon which standards and policies may be based. Among the current studies is a statewide survey of rigid pavements similar to a previous survey of flexible pavements which resulted in improved specifications and design procedures.

Contract Plan Review

In the 1961-62 fiscal year, 390 projects were processed in comparison to 412 in the previous fiscal year. Approximately 6,600 sheets of contract plans were reviewed in preparing these projects for advertising; this is 700 sheets less during the preceding year.

While the total number of projects shows a small decrease, the average project size and complexity have increased considerably. The decrease in the number of contract plan sheets is due in part to the fact that federal-aid secondary projects are no longer processed in the Design Department; they are now handled entirely by the City and County Projects Section. More significant is the decrease in the total number of sheets required for comparable projects due to improvement in plan preparation methods.

Research and Special Studies

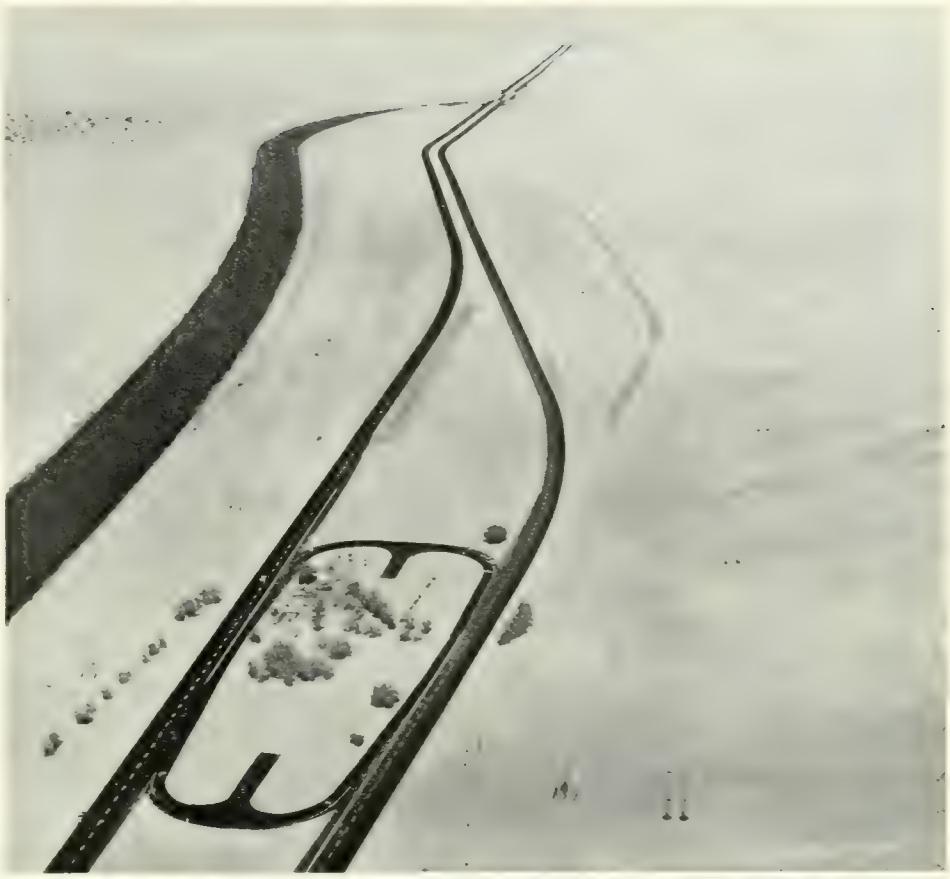
Several studies relating to freeway design are presently under way in co-operation with the districts and other departments.

An investigation is being made of the use of models to help determine the design of complicated interchanges so that they will offer the most satisfactory operating conditions.

The costs of various median widths are being analyzed to determine the possible need for a greater basic width.

Several types of branch connection designs at freeway-to-freeway interchanges are being developed to determine the best type for specified design and traffic conditions.

An investigation has been completed as to the proper warrants for location of ramp terminals at crossroads, particularly in relation to sight distance at overcrossing structures.



Former site of the Sand Hills Maintenance Station in Imperial County, now used as a safety rest area on U.S. 80 (Interstate 8).

Drainage and Co-operative Agreements

The great increase of freeway construction in urban areas has added to the complexity of drainage problems. Urbanization of an area often requires changes in drainage outside the limits of the freeway and beyond the normal scope of highway drainage work. In some cases comprehensive drainage improvements have been accomplished through co-operation of state and local agencies. In several instances, marked drainage improvements for the community have been made in conjunction with the construction of freeways. The use of highway funds in such drainage improvements is limited to the cost of perpetuating existing conditions and protecting the highway from flooding or damage.

Co-operative projects for local street rearrangements and betterment agreements have increased. Co-operative agreements also have been used more frequently for the excavation of needed freeway material from planned public works such as channel improvements. This type of agreement usually results in savings to both the State and the public agency concerned.

During the fiscal year, severe storms in portions of Southern California provided a good test of the freeway drainage design and showed that the highway drainage systems handled the most severe storms with minor ponding on the freeway. Only a few isolated ramps were closed because of the local street flooding.

Erosion Control and Roadside Development

Since it is a highly specialized activity, the roadside development unit has in the past prepared all plans for functional planting and landscaping projects in Sacramento for the districts. During the 1961-62 fiscal year, plans and specifications for 33 budgeted projects were completed.

A study is being made to determine the advisability of creating landscape sections in the San Francisco and Los Angeles metropolitan areas.

Certain items necessary for erosion control and landscape preparation can more economically be handled under major construction contracts. All typical cross sections for all projects are reviewed with this in mind. The landscaping preparation includes such items as contour grading, deep cultivation, spreading topsoil and installing waterlines or encasements for future waterlines under roadways.

During the fiscal year, 33 functional planting and landscape projects valued at $3,475,000 were financed. The following list of quantities involved in these projects will give an idea of the amount of work entailed in the design preparation: 4,185 tons of straw, 149,690 pounds of seed, 626 tons of commercial fertilizer, 374,850 assorted trees and shrubs, and 4,199,940 ground cover plants and cuttings.

Most of the trees and shrubs are furnished by the contractors from commercial sources. A major portion of the state-furnished trees and shrubs also are purchased by the State from commercial nurseries. In many cases a contract to propagate and grow such plants is entered into between the State and a commercial grower. When the plants have reached the proper size they are delivered to the State nursery at Davis or the holding yard in Los Angeles where they are picked up by the contractor.

Some varieties not generally grown by commercial nurseries have proved adaptable for roadside use and are propagated at the State Nursery. Also many freeway planting projects require larger quantities of certain plants than the commercial nurseries can afford to handle without definite orders and delivery dates. These, along with plants for experimental purposes also can be better furnished by the State.

TRAFFIC

In 1961 motorists traveled approximately 35 billion vehicle-miles over all state highways in California, about 47 percent of the total travel in the State. Nearly half of the travel on the state highway system was in cities. 1961 statewide travel showed an increase of 4.4 percent over 1960.

Under the new traffic-counting system, which was described in the last annual report, 40 full-time employees can determine traffic volumes with new automatic and self recording equipment. Under the old manual system of counting, some 390 temporary employees were needed each month, except in July when 6,200 temporary employees were required to take the annual summer count. The cost of conducting the traffic census has been reduced from an average of $642,000 in previous years to $422,000 for the 1961-62 fiscal year. The current cost is based on $395,000 for salaries plus 10 percent depreciation per year on the $270,000 cost of the new equipment. The annual savings is therefore $220,000.

A new format has been adopted for the *Annual Traffic Census* booklet. The former raw count data (16-hour Sunday and Monday July counts) were replaced with annual average daily traffic and peak seasonal ADT columns. The new booklet uses a county-route-postmile system for identifying count locations and an improved list of intersection and landmark names to make the information more meaningful. A detailed average daily traffic profile can now be plotted directly from the booklet.



E. J. McCall, Service Manager of the Southern Division of the National Automobile Club, plays the part of a motorist in distress to illustrate the use of one of the 80 emergency call boxes which have been installed on Los Angeles freeways.

The total accident rate per million vehicle-miles and fatality rate per 100 million vehicle-miles on the rural state highway system was 2.38 and 8.62 respectively, for 1961. The comparable rates for the combined rural and urban freeways was 1.28 and 2.89, respectively.

In January 1962, a highway safety research unit was established in the Headquarters Traffic Department to devote full-time research to highway safety. Among the projects currently under study are:

1. Evaluation of minor improvements and development of criteria for their use.
2. Wrong-way driving on freeways and their connections.
3. A comparison of freeway sections to determine reasons for dissimilar safety records.
4. A two-year median barrier evaluation.
5. Relation of ramp type to accident rates.

Geometric Standards and Traffic Service

Research continued on several phases of freeway operations to develop relationships between traffic op-

eration and geometric design. Studies completed or in progress include operational effects of weaving and merging traffic and effects of slow moving vehicles. A study entitled "Traffic Behavior and Off-ramp Design," made in co-operation with the U.S. Bureau of Public Roads, was also completed.

A unique study was undertaken on freeways in the Los Angeles area to obtain information on trip characteristics. This study involved the photographing of vehicle license plates with motion-picture cameras at several locations on the freeway system, looking up the addresses of the vehicle owners from Department of Motor Vehicles records, and then mailing out a questionnaire to each owner in order to obtain information about his trip. A followup questionnaire will be mailed to the same motorists later in the year, to determine if they travel on different routes as a result of completion of several new freeway projects during the year.

Traffic Signals and Illumination

Contract plans were completed for 153 new traffic signals and modernization of 169 existing signals. Contract plans were also completed for 3,721 lighting standards and 393 illuminated traffic guide signs. The total estimated cost of the electrical work was $7,218,255 not including the cost of steel sign structures.

A total of 217 traffic reports reviewing conditions at approximately 522 intersections were made to determine the need for traffic signals or lighting.

Research projects underway or completed include the following:

1. Continuation of research by a private firm to develop a nuclear-energized self-luminous highway directional sign.

2. Complete development of a new vandalproof fluorescent lighting fixture for use in pedestrian undercrossings.

3. Began research to develop a method of providing lights in the pavement for illuminating the underside of trucks at truck weight station inspection areas.

4. In co-operation with the Highway Patrol, conducted tests at truck weigh stations to improve visibility for operators inspecting truck-trailer couplings while vehicle is being weighed.

5. Concluded tests on an electroluminescent highway directional sign.



Restrictive pavement markings are painted at the ends of freeway offramps to prevent wrong-way entrances.

Plans and specifications were completed and installation begun on an experimental emergency call box system on 10 miles of freeway in the City of Los Angeles. The system consists of 80 solar-powered battery operated radio transmitter type call boxes spaced ¼ mile apart to the right of each roadway. A motorist in distress can summon a police officer by pushing a button on the box. The responding officer can open a locked compartment on the box and call for any of 14 services as required by the situation. This is believed to be the first installation of this type in the United States.

Traffic Regulation and Control

A new edition of the *Manual on Uniform Traffic Control Devices for Streets and Highways* to which all States are required to conform on roads involving federal participation in financing, was published by the U.S. Bureau of Public Roads. To avoid a double standard in the State, the new national standards have been adopted for all state highways. A complete inventory of all existing highway signing has been initiated in order to establish a practical program to bring all highway signing up to present day standards.

All new signs ordered now conform to the new national standards. This required revision of the sign specification sheets prepared for sign manufacturers and the publishing of a new edition of the *Planning Manual—Part 8, Traffic*. This revision included all of the revisions required to conform both to the national manual and legislative changes enacted by the 1961 Legislature. The manual was widely distributed to city and county highway and traffic officials in order to promote greater uniformity in the use of traffic control devices throughout the State.

A new edition of the *Manual of Warning Signs, Lights and Devices for Use in Performance of Work Upon Highways* was published and distributed. A new edition of the *Uniform Sign Chart* was also published and distributed; and a new edition of the *School Crossing Protection* pamphlet was published on January 1, 1962, and distributed to school superintendents and other interested officials. All these new manuals were prepared in conformance with the new national standards.

Traffic control measures taken during the year included:

238 restricted speed zones were established and 42 existing speed zones were removed, resulting in 82 additional miles of speed restrictions of state highways.

66,361 highway signs were approved for installation, comprising 27,890 warning signs, 15,214 regulatory signs, 16,422 guide signs and 6,835 construction and miscellaneous signs.

HIGHWAY PLANNING SURVEY

The Planning Survey Department is composed of two main operating units, collaterial engineering and statistical-financial.

Engineering and economic investigations usually are statewide or affect more than one district. Many such studies are undertaken at the request of the U.S. Bureau of Public Roads. Other studies are authorized by the State Legislature. Most of the studies are financed partly by Federal "Research and Planning" funds which amount to a maximum of 1½ percent of the total annual federal-aid apportionment to California.

Drafting Section prepares maps, plates, and exhibits for headquarters departments, and for studies and reports in connection with all phases of work of the Planning Survey.

An Electronic Data Processing and Machine Methodology Section provides data processing and electronic computer services for Planning Survey and other departments as well as for the districts and other divisions of the Department of Public Works.

The planning library is also a Planning Survey unit.

Engineering Studies for the Legislature

Legislative studies underway during the 1961-1962 fiscal year included:

S.C.R. No. 6, 1962, which requests a study of a Humboldt Bay Crossing. Traffic investigations are underway, the Bridge Department has started test borings and is preparing a cost estimate on a proposed alignment. Field reviews of the area by Planning Survey have been made. The report is due prior to the start of the 1963 session.

S.C.R. No. 8, 1962, which requires a study of the renumbering and naming of highways, freeways, and expressways. The Planning Survey and Traffic Departments are jointly responsible for this study.

S.R. No. 26, 1962, which concerns the development of recreational areas along rivers where crossed by bridges. Representatives of the Departments of Public Works and of Parks and Recreation have met and made joint field trips.

S.C.R. No. 4, 1962, which is a further development of S.C.R. No. 39 adopted in 1961, authorizing preparation of a report on recommendations for a statewide system of scenic highways. The report on a preliminary plan for scenic highways was issued on March 15, 1962, by the Department of Public Works as a joint effort of a citizens advisory committee and an interdepartmental co-ordinating committee. As a result, workshop meetings with local interested groups were scheduled in the various highway districts to discuss the proposed scenic highway system. Subsequently, a revised system will be delineated and



Workshop discussions were held throughout the State in 1962 in connection with continuing studies looking toward a system of scenic highways. This one was in San Luis Obispo.

a new report submitted to the Legislature.

S.C.R. No. 20, 1962, which requested preparation of a detailed technical prospectus covering the scope and objectives of a comprehensive transportation study of the nine counties adjoining San Francisco Bay, including such matters as a review of all land use, transportation and economic development studies in the field of transportation. The prospectus was to be completed by November 1, 1962.

In addition to the major studies and reports outlined above, Planning Survey has spent some time on several other studies covering such diverse matters as rest areas along noninterstate highways, naming of specific state routes in honor of persons, emergency call boxes on state highways, and compensation to cities for bus turnouts on freeways.

Studies for Bureau of Public Roads

Preparation in graphical form of physical and traffic features of all existing traversable routes for the interstate system was completed in September 1961. This is known as the interstate traveled-way study.

A new project, Interstate Accident Study II, is being conducted on selected portions of the interstate system to determine the effects of geometric design features on highway safety. Two portions of Interstate Route 80 have been selected: from Powell Street in Emeryville to north of Redwood Street in Vallejo, urban in character; and a rural section from Roseville to Auburn. Co-operating with the Planning Survey in this work are the California Highway Patrol and the Bureau of Public Roads. Results will be correlated with a nationwide study.

Another major project, which has been submitted to the BPR, concerns additions to and renumbering of the entire federal-aid primary system. Proposed primary additions of more than 600 miles are chargeable against an increment authorized under federal statutes. Strip maps delineate each separate primary route. State maps and enlargements show the proposed renumbering which integrates the additions with the existing system by a minimum of new routes. The proposed renumbering achieves better continuity and reduces the total number of routes by combining shorter sections. Finally, numbering of primary routes which underlie the interstate system has been clarified and simplified.

A continuing project is the preparation of maps of urban areas to show urban boundaries for the administration of federal-aid funds by the Bureau of Public Roads. Maps have been made for new urban areas disclosed by the 1960 census, and revisions are in process for approximately 30 other areas with outdated maps. Dozens of cities have been combined in three metropolitan area maps: one for the San Francisco-Oakland-San Jose area; another the entire Los Angeles-San Bernardino region; and the third for the San Diego urban area.

Other Engineering Studies

Field reviews by joint Headquarters-district teams were made of certain traversable roads between the termini of unconstructed state highway routes authorized by the Legislature. Reports were prepared, with descriptions, photographs, route maps, and traffic data.

Statistical Studies

The development of methodology and also the data processing for the long-term Los Angeles Regional Transportation Study (LARTS) has continued to be a major statistical study for the highway planning survey during the year. The basic analyses of relationships from the survey data have been completed to the extent that trip generation factors for the trip development model have been accepted for a preliminary assignment to the 1960 network. The 1960 network has been completely described in numerical terms and processed on the computer. It is expected that distribution from the model will be completed and assignment of trips from the model, as well as trips developed directly from survey data, will be completed and assigned to the 1960 network by the end of August 1962.

Completed during the year as a basis for the model development and the processing of the trip data were the methodology and computer programs which made it possible and reasonable to deal with the LARTS study area as a single integrated system. The area contains 9,000 square miles and a present population of about 7 million persons. The number of detailed traffic zones in this study area totals nearly 2,400. To handle a system of this size a sector approach was developed to handle the processing of the shorter trips. The longer trips were processed on a major zone system comprised of nearly 300 zones.

Financial Studies

Three co-operative studies with the U.S. Bureau of Public Roads were carried on:

The annual local road and street finance report covering transactions of fiscal year 1959-60 was completed.

In the roadlife and pavement cost study, basic data on the 12,000 miles under study were recorded through 1959 and compilation of tables for the Bureau of Public Roads begun.

A post mileage was added to the 1961 status of highways based on the 1960 status mileage.

Data Processing Activities

During the past year the data processing capabilities of the Division of Highways were augmented by the addition of two 1401 data processing machines and by the conversion of some standard programs to use the full capabilities of the 704 which was purchased in 1961. Processing of a routine nature as well as for special reports and special subjects continued during the year. Accounting data were processed, although development in this area is still continuing.

Rapid transmission of data between one district and Headquarters was begun on an experimental basis, and success in this area is now leading to enlargement of data transmission facilities. The punched card processing load dropped slightly and some tabulating machine operators were retrained as procedure and program developers to use the newer equipment.

General use of the standard engineering services provided by the highway planning survey has increased due to more rapid transmission and to general acceptance by the engineer. Approximately 10,000 traverse courses per day and earthwork quantities of 16,000 cross sections monthly are being calculated by this service.

• Bridges

• *The Bridge Department is under the administration of the Assistant State Highway Engineer—Bridges and is responsible for the design, construction and maintenance of all bridges and structures on the state highway system*

A branch office of the Bridge Department is located in Los Angeles to maintain liaison with southern area districts, perform planning functions and supervise construction and maintenance of structures within these districts. All other functions, including design work, are handled at headquarters in Sacramento.

The department is divided into five sections—Planning, Operations, Special Studies, Office Engineering, and Special Projects. The maintenance and operation of state-owned toll bridges are also under the administration of the Bridge Department.

BRIDGE PLANNING

Advance planning work of bridge site investigations, collecting and assembling data and preparing preliminary design reports was more extensive in fiscal year 1961-62 than in any previous year. Engineering design was initiated on 577 structures, 40 more than the former high in 1956-57 and 9 percent more than in 1960-61.

Close coordination of highway and bridge planning is maintained throughout all phases of project development. Alternative structure types are studied as to feasibility, cost and appearance.

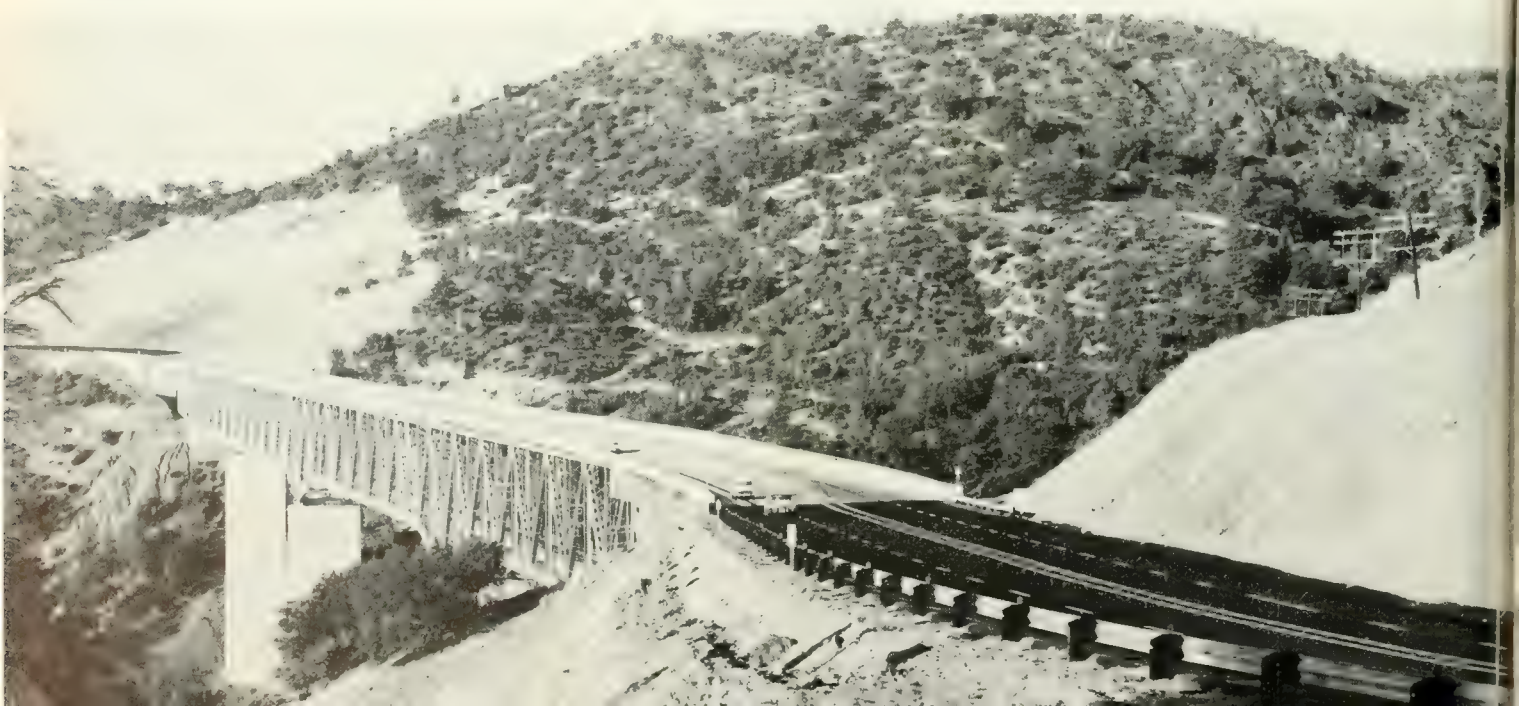
Recently examined as possibilities for portions of several metropolitan freeways were single- and double-deck viaducts; multilevel interchanges; underwater tubes; fixed and movable bridges over navigable waterways; high-level, long-span bridges and a large variety of highway separation structures. In the case of the proposed Route 105 crossing of Upper Crystal Springs Reservoir in San Mateo County, one of the alternative routes may be practically eliminated from consideration because the cost of building bridge piers in deep water through 90' of peat would be excessive. Through the co-operation of the San Francisco Public Utilities Commission foundation explorations were made from a barge in such a manner as to avoid pollution of this very important water supply.

Architectural Bridge Design

To illustrate the effect on the landscape of a high-level or a low-level route around Emerald Bay several scale models were constructed showing highway cuts and fills, tunnels and snow sheds in detail. These models were displayed at meetings of the Park and Highway Commissions. In addition, a photographic brochure of both the high-level and low-level all year lines was made.

To meet an increasing demand for visual aids during the fiscal year the Bridge Architectural Section made 75 sketches and renderings, 27 photo retouches and 16 models. Noteworthy success was achieved in the combined use of renderings and photo retouches of the Upper Newport Bay crossing.

PHOTO BELOW—The new West Branch Feather River Bridge on U.S. 40 Alternate in Butte County



Models have proven particularly effective, especially in court cases.

Foundation Section

The Foundation Section is in the process of acquiring a compact, portable seismic unit which will greatly speed foundation studies in difficult terrain where equipment access is a major problem.

The section is presently involved in a research program on the settlement of approach embankments. Correlations are being made at numerous sites between calculated theoretical settlements and actual settlements of the embankments when in place. The aim of the program is to be able to predict settlements more accurately thus minimizing problems effecting bridge construction and maintenance caused by embankment settlements.

The section is also continuing its pile load test program throughout the State in order to increase the economy of foundations through wider application of pile types and increased loadings.

During the past fiscal year, the Foundation Investigation Section completed a total of 697 foundation studies for bridge and freeway structures. In addition, a total of 113 foundation studies for retaining walls was completed.

A total of 110,673 lineal feet of exploratory borings was drilled during the year to determine foundation conditions at the various sites. Foundation studies were completed for many large structures including the proposed Yolo Bypass Section of the West Side Freeway, Crystal Springs Reservoir Crossing, Sacramento River, Colorado River Bridge at Topock, and major interchanges in the Los Angeles area.

Design

Among the many structures designed during this fiscal year, one of the most interesting was the substructure of the Sacramento River bridge between W and X Streets. The total cost of this bridge will be approximately $12,000,000. The total length of bridge is about 5,500 feet, with two main river channel spans of 275 feet.

Another interesting bridge design was the Cold Spring Canyon Bridge, located on the San Marcus Pass Road, about 15 miles north of Santa Barbara.

The 700-foot steel arch span and approach spans make up a total bridge length of 1,218 feet. The two-lane roadway is supported on two arch ribs, each of which is made up of a box section 9 feet high by 3 feet wide. The arch ribs have a rise of 120 feet and spring from the canyon walls so that the deck soars more than 325 feet above the floor of the canyon.

There are 1,438 tons of steel in the arch, and a total of 2,326 tons in the bridge. The contract price was $1,948,638 for the bridge work.

Bridge Construction Costs

Bridge construction costs, as measused by the department's cost index, began the year with an index value of 261 which advanced during the succeeding four quarters to 269, 273, 264 and 288. Bridge construction costs were 5 percent higher during the fiscal year 1961-1962 than during the previous year.

BRIDGE OPERATIONS

Forty-three Bridge Department-administered contracts were completed during the year at a total cost of $56,556,000. Four large contracts on the Santa Monica Freeway Viaduct, the West Branch of the Feather River and the Benicia-Martinez substructure account for $46,297,000 of the above figure. Approximately $65,530,000 in structure work was completed on 81 district-administered contracts for an overall total of $122,086,000 involving 124 contracts and construction of 438 new structures, as well as a number of retaining walls and the widening and repair of existing structures.

At the end of the fiscal year, 182 structure projects were under way with an approximate cost of $222,303,000. This includes funds for the Benicia-Martinez superstructure, the San Pedro-Terminal Island sub- and superstructure contracts, projects financed from various fiscal year budgets and work on federal-aid secondary projects.

The 1961-62 state highway budget had $68,506,000 in structure work in 95 projects. Miscellaneous projects including maintenance, FAS, and work for other agencies $2,606,000 for a grand total of $71,112,000. All structures in this budget year are either completed or under contract.

Metropolitan Freeway Structures

In Oakland, extending southeast from the Bay Bridge distribution structure, work was completed and traffic began using 18 bridge structures costing over $7.5 million on the first section of the MacArthur Freeway. Two additional contracts on this route totaling about $4 million in 25 structures are well along.

Widening of five structures to convert the heavily traveled Nimitz Freeway in Oakland from six to eight lanes is more than half complete.

Bridge work on 14 structures for the freeway extending south from the new Benicia-Martinez Bridge in Contra Costa County is nearing completion. On this same route and farther south toward Walnut Creek and Danville 22 bridge structures have been started.

In San Francisco construction started on the Southern Freeway between Ocean Avenue and Mission Street north of Alemany Boulevard. Work was 50 percent completed on the section of the Southern Freeway between Milton Street and the James Lick Memorial (Bayshore) Freeway along Alemany Boulevard.

Among notable projects completed in the Los Angeles area were three contracts for the construction of the Santa Monica Freeway Viaduct linking the Golden State, Santa Ana, and Harbor Freeways. This eight-lane viaduct carries traffic overhead for 4.8 miles through the industrial section of Los Angeles from the Los Angeles River to Hoover Avenue just west of the Harbor Freeway.

On the Golden State Freeway, 40 structures were completed and 34 others are under construction. One of



Construction inside the Collier Tunnel through the Hazelview Summit on U.S. 101 in Del Norte County.



The west portal of the Caldecott Tunnel on Sign Route 24 east of Berkeley.

the completed structures is the half-mile-long Elysian Viaduct which carries the eight-lane Golden State Freeway traffic over the Los Angeles River, adjacent railroad yards, city streets, and at its southerly end develops into a system of curved ramps to make possible the interchange with the Pasadena Freeway. Another major interchange completed on the Golden State Freeway is the Glendale Freeway Interchange which includes eight structures.

Construction along the San Diego Freeway is continuing at a rapid pace. Sixteen new structures were completed and 131 were in various stages of construction at the end of the fiscal year.

Progress continued along the Ventura Freeway with the completion of 11 structures and 40 more under construction. The first sections of the Newport Freeway from the City of Orange to the Riverside Freeway, including 11 structures, were completed. Contracts are underway for 12 more structures along this freeway.

In the San Bernardino - Riverside area, 66 structures were completed and at the close of the year 59 structures were under construction.

In the San Diego area, 43 structures were completed and 54 additional structures are under construction. Among the completed structures in this area is a four-level interchange in the heart of San Diego, connecting U.S. 395 and 101.

Other Major Projects

The Randolph Collier Tunnel, located in Del Norte County approximately two miles south of the California-Oregon border on Highway U.S. 199, is to be 1,884 feet long. The tunnel will be concrete lined, will have concrete pavement and provide two 13-foot traffic lanes and safety walks on each side.

Construction of the tunnel started in January 1961. At the end of the fiscal year excavation was well advanced and placement of concrete tunnel lining was in progress. Construction of the tunnel, including the lighting and ventilation system should be completed about the middle of 1963.

Work on the Caldecott Tunnel through the Berkeley Hills on Sign

Route 24 reached the actual tunneling stage in mid-November 1961. Tunneling operations will continue throughout the coming year with completion anticipated in early 1964. The total estimated cost of the tunnel is $10,500,000.

On the Webster Street Tube all 12 precast tube segments have been towed into place, lowered into position, and backfilled. Work is underway on 812 feet of cast-in-place tube segment on the Oakland end. The $20 million tube located under the Oakland Inner Harbor between Alameda and Oakland, which should be complete early in 1963, will carry traffic from Oakland to Alameda. The Posey Tube, located one block to the east, will be used to carry traffic from Alameda to Oakland upon completion of extensive renovation.

The past fiscal year saw the completion of two large steel structures on major highway relocations around proposed dams and reservoirs. The first one was the Whiskey Creek Bridge, which carries U.S. 299 over the Whiskey Creek arm of the proposed Whiskeytown Reservoir about 10 miles west of Redding. This structure, costing $1,100,000, is a welded steel, plate girder bridge. High strength alloy steels were used in the girders to reduce the total weight of steel required.

The other structure, the bridge across the West Branch Feather River, carries relocated U.S. 40 Alternate and the Western Pacific Railroad across an arm of the reservoir which will be formed by construction of the Oroville Dam. This double-deck bridge, carrying four lanes of highway traffic on the upper deck and a single railroad track on the lower deck, is 2,731 feet long and has three unusually large piers, two of which are some 280 feet from foundation to top of pier. Total cost of the bridge was $8,600,000.

County and City Bridges

Advice and assistance continued to be extended to the counties for bridges on the federal-aid secondary system. The flow of technical aid to the cities was improved through the extension of the duties of county bridge projects engineer to include city projects financed from city apportionments of the gas tax.

Twenty contracts involving 30 FAS bridges valued at $2,700,000 were awarded during the year.

Of the 30 structures, plans for all but 6 were prepared by county forces. Construction engineering for 24 of the structures is being performed by the counties.

Bridge Maintenance

The Bridge Maintenance Section continued the periodic field investigations of the 7,006 bridges on the State Highway System. This includes reports and plans for needed repairs and minor improvements, the review and updating of capacity ratings, and scheduling of replacement of structurally critical bridges as necessary.

On October 25, 1961, a Coast Guard cutter responding to an emergency call from a yacht moored in the small bay at Moss Landing rammed the 12-span, 360-foot long concrete bridge

Bridges on the State Highway System Segregated as to Number, Length and Area by Structure Type, as of June 30, 1962

Structure type	Number 1962	Number 1961	Length [a] (feet) 1962	Area [b] (square feet) 1962
Concrete arch	239	240	39,469	889,241
Concrete girder	1,892	1,752	417,518	27,034,980
Concrete slab	2,358	2,278	142,932	6,062,911
Masonry arch	33	33	962	21,735
Subtotal concrete and masonry	4,522	4,303	600,881	34,008,867
Steel arch	5	5	1,708	26,760
Steel plate girder	350	339	184,794	7,006,815
Steel stringer	282	285	62,299	3,742,887
Steel deck truss	29	30	24,415	1,196,200
Steel pony truss	30	32	10,609	171,853
Steel through truss	65	69	116,469	1,478,678
Suspension	2	2	15,097	884,145
CMP multiplate and arch	74	67	1,440	48,537
Subtotal steel	837	829	416,831	14,555,875
Timber arch	2	3	343	1,768
Timber stringer	605	622	44,060	2,101,095
Timber deck truss	8	10	1,820	29,335
Timber pony truss	1	1	127	2,899
Timber through truss	1	1	79	1,722
Subtotal timber	617	637	46,429	2,136,819
TOTAL BRIDGES	5,976	5,769	1,064,141 (202 miles)	50,701,561 (1,164 acres)
Underpasses	182	186		
Overheads *	242	223		
Combined bridge and overheads *	48	46		
State highway separations *	272	249		
Road undercrossings *	952	823		
Road overcrossings	725	632		
Pedestrian undercrossings *	157	155		
Pedestrian overcrossings	78	71		
Cattlepasses *	88	84		
Tunnels	20	20	14,199	
Retaining walls	6	6	4,707	
Miscellaneous	19	21	1,909	20,266
TOTAL STRUCTURES	7,006	6,705	1,084,956	50,721,827
Drainage pumping plants	185	180		
Railroad grade crossings	676	682		

* Separations so noted are listed under structure type above.
Note: One underpass, 18 overheads, 1 tunnel, and 3 bridge and overheads also serve as state highway separations.
[a] Structures of assorted types and lengths of spans are by number and length of main span.
[b] Areas are based upon clear width of roadway between curbs and clear sidewalk width.



Part of the panorama from the Elysian Park view point in Los Angeles showing part of the viaduct (foreground).

across Elkhorn Slough, about 18 miles north of Monterey on State Sign Route 1. One-half the bridge was pushed 18 inches out of line by the impact and some of the concrete piles, caps and a portion of the deck were damaged. Immediate investigation indicated that traffic could continue to use the bridge safely until necessary repairs were made by contract.

A series of minor earthquakes near El Centro in Imperial County caused a wedge of earth at the west abutment of the twin bridges across New River at Seely on U.S. 80 to slip toward the river. This movement bent and shattered the supporting concrete piles so badly that the structure had to be closed to traffic on February 5, 1962. Repair work started under an emergency contract and the bridges reopened on February 16.

The Bridge Maintenance Section made engineering investigations at the request of local authorities on 67 city and county bridges to establish their load carrying capacity. Thirteen public hearings were held as a result of which 21 of these bridges were posted for less than legal loads.

As a result of new construction two bridges on the state highway system with load postings and three with speed postings have been dropped from the posted bridge list. On June 30, 1962, there were no bridges on any state highway having a load posting although three ferry crossings are still posted for reduced loads and 34 bridges for reduced speed.

Bridge Maintenance Painting

Three maintenance painting contracts on six structures were completed at a cost of $240,000. Railing revision and repair on one bridge and replacement of bracing members on another was included in one of these contracts. Railings on two bridges on U.S. 99 in District X were repainted.

Despite higher initial painting costs, the annual maintenance unit costs show a downward trend. This reflects increased service life of paint because of more advanced methods of cleaning and application continued rigid inspection techniques and better materials.

Seven experimental sections were painted this year as a part of a continuing paint study program. Evaluation of experimental painting on the Leffingwell bridge on State Route 1 indicates results far better than anything heretofore obtained.

SPECIAL STUDIES

An expanding program of structural research has permitted investigation of a wide variety of subjects. Nearing completion is a study of the characteristics of a concrete box girder bridge.

Other active research projects concern concrete cracking, the effects of earthquake forces on long piles, the effects of friction on prestressing units in concrete, and the use of epoxy adhesives and sealants.

Most of this work is financed in part by federal-aid highway funds for research and is conducted in co-operation with the Materials and Research Department and the University of California Institute of Transportation and Traffic Engineering.

The development of electronic computer services for bridge design and analysis has kept pace with growing demand and the installation of improved computing equipment.

Emphasis this year has been on refinement and expansion of an existing program aimed at taking advantage of new computing power and capacity. An example is the mathematical simulation of trucks crossing a bridge, with automatic selection of truck size and position for critical stresses at various locations. This program also provides for distribution of resulting moments and computation of shears to produce final design data for the bridge superstructure.

Progress has also been made in training bridge engineers to write their own computer programs by means of an automatic coding system. This permits timely programming of problems by those most familiar with their definition and solution. About 50 engineers have received elementary training in the use of this system.

The publication *Bank and Shore Protection in California Highway Practice* was distributed and is receiving wide usage. As in the past, studies in the fields of hydrology, hydraulics, and bank protection are being continued.

BRIDGE OFFICE ENGINEERING

Bridge office engineering includes the administration and management of the various service units.

A major function is the negotiation and preparation of maintenance and construction agreements with railroads in connection with construction of railroad grade crossings and grade separations.

Railroad Grade Crossings

Construction was started, underway or completed on 62 highway projects requiring negotiations with railroads which involved right-of-way encroachments, installation of additional crossing protection, construction, alteration or abandonment of grade crossings. At the end of the fiscal year, negotiations with the railroads were in progress for 18 additional highway projects upon which construction had not yet started. In addition to the above, 29 projects involving improvement of existing crossing protection were completed or underway.

On federal-aid secondary routes, negotiations were underway or completed on 37 projects with railroad involvement.

Railroad Grade Separation Structures

At the beginning of the year, 70 railroad-highway grade separation structures were under contract. Some 46 grade separation structures were completed during the year. Contracts were awarded for an additional 42 structures. Three of these projects, which were awarded during the fiscal year, have been completed.

The railroads contributed a total of $275,319 toward 10 of the 49 completed structures.

$5 Million Grade-crossing Fund

The Public Utilities Commission issued the 1961 priority list containing 34 proposed separation structure projects to eliminate railroad grade crossings on county roads and city streets. In accordance with state law, $5,000,000 in state highway funds is set aside by the Highway Commission each year to pay half the cost of each separation project after deducting the railroad contribution.

As of June 30, 1962, allocations totaling $3,400,285 had been made by the Highway Commission from the 1961-62 fiscal year funds for 7 of the 34 projects on the PUC list.

SPECIAL PROJECTS

Carquinez and Benicia-Martinez Bridges

The Legislature, in the spring of 1955, authorized the construction of two new bridges across the Carquinez Strait, each to be financed by revenue bonds supported by the tolls from both bridges. The new parallel Carquinez Bridge was the first to be built and was opened to traffic on November 25, 1958. The Benicia-Martinez Bridge was opened to traffic in the Fall of 1962, a little more than seven years since passage of the legislation.

Traffic across the new parallel Carquinez Bridge, since the day it opened, has remained well above expectations and has shown an annual increase of approximately 7.5 percent. Total traffic for 1961 of 13,833,083 vehicles indicates the great traffic demand the project is now accommodating.

The $5,800,000 substructure contract for the Benicia-Martinez Bridge was completed on January 15, 1962, almost three months ahead of schedule. And the last placement of structural steel for the trusses and girders of the superstructure contract was made in May, 1962. The bridge was opened to traffic on September 15, 1962.

The Benicia Freeway approach on the north was placed in use at the time the bridge was opened to traffic. The south freeway approach was nearing completion and was in partial operation.

The estimated annual traffic across the Benicia-Martinez Bridge is expected to total approximately 2,000,000 vehicles. Toll charges on the Benicia-Martinez Bridge will be identical to those charged at the two Carquinez Bridges, 25 cents for a passenger car with a liberal commuter rate of 10 cents per car.

Vincent Thomas Bridge

The Vincent Thomas Bridge, connecting San Pedro and Terminal Island, is the third largest suspension bridge in California. This bridge with its main span of 1,500 feet will be an impressive and beautiful structure dominating the landscape in the San Pedro area.

The $2,650,000 substructure contract begun May, 1961 was completed in June, 1962. Work on the superstructure is progressing on schedule. The two main steel towers have been erected, with spinning of the steel cables to follow. The $11,400,000 superstructure is due for completion in December, 1963.

The $2,000,000 approaches to the structure, started in February 1962, are due for completion in August 1963. This contract includes the Administration Building and toll booths on the Terminal Island side.

Financing is by tolls to be collected when the bridge is opened to traffic. Estimated cost for construction, right of way, and engineering is $20,800,000. Of this amount, $5,000,000 was raised by the sale of revenue bonds. Of the remainder, $2,000,000 each was loaned by the City and County of Los Angeles and the rest from the State Highway Fund.

San Diego-Coronado Highway Toll Crossing

The Legislature in 1961 and 1962 set up funds for preliminary studies, plans, and rights of way for the construction of a toll tube or toll bridge across San Diego Bay between San Diego and Coronado.

Studies have been made for five different tube lines and four bridge lines. The bridge studies were for four-lane roadways and the tube studies for two-lane roadways. This was because early estimates indicated that four-

lane tubes would not be financially feasible while four-lane bridges could easily be financed by revenue bonds.

A public meeting was held on June 6, 1962, in the Coronado High School to present the studies and the data that had been collected.

A progress report was made after the end of the fiscal year to the California Toll Bridge Authority which took action to continue the studies.

Personnel

The total Bridge Department personnel was last reported in the 1952 annual report. The following table will fill in this discontinuity:

Year	Total average personnel
1953	565
1954	663
1955	697
1956	786
1957	865
1958	903
1959	926
1960	903
1961	945

STATE-OWNED TOLL BRIDGES

San Francisco-Oakland Bay Bridge

A record total of 40,521,508 vehicles crossed the San Francisco-Oakland Bay Bridge during the year. This is an increase of 1.7 percent over the previous year. The daily average for the year was 111,018 vehicles.

The month of highest average daily traffic was June 1962, with a new record high of 115,709 vehicles per day. The previous high was in June 1961, when the daily average was 114,401 vehicles. New high figures for a single day's traffic were established in two successive months during the fiscal year—first on August 18, 1961, with 131,911 vehicles, and again on September 1, 1961, with 133,064 vehicles. Both of these record days were Fridays, and it is interesting to note that every record high day in the history of the bridge has been a Friday. The highest record for the preceding year was 131,826 vehicles on June 16, 1961.

The revenue derived from vehicular tolls, rent, and miscellaneous services, exclusive of interest, was $12,346,805. This was an increase of $252,294 over the preceding year.

Reconstruction of the eastbound toll plaza was completed. The rebuilt and enlarged plaza provides 17 toll lanes with all toll booths arranged to collect from the driver's side of the vehicle. The completed plaza was designed to accommodate traffic after the bridge is converted to one-way traffic on each deck.

A contract for remodeling the westbound toll lanes and toll plaza was approved in June 1962. When the project is completed, the westbound plaza will also have 17 modern toll lanes.



An aerial of the San Pedro-Terminal Island Bridge just after the stringing of the suspension cables over the towers began.

The contract for major repairs to the timber fenders which protect bridge piers in the navigation channels was completed.

Work was underway on a final contract for 7,560 feet of the lower deck traveler scaffold system which provides for the erection of two rails, each 6,700 feet long, in the East Bay crossing, and two rails, each 860 feet long, under the continuous spans just west of the suspension bridges. Four traveling platforms, each about 19 feet by 73 feet in dimension will be suspended from the rails. These traveling scaffolds will provide a safer work area for the men and will greatly reduce the man hours the paint crew spends in rigging conventional hanging scaffolds.

The San Francisco Division of Bay Toll Crossings continued work on the $35,000,000 remodeling which will convert the bridge for five lanes of one-way traffic on each deck.

San Mateo-Hayward and Dumbarton Bridges

The total traffic on the San Mateo-Hayward Bridge for the year was

4,016,930 vehicles; the toll revenue amounted to $1,538,851.70. For the same period, the traffic on Dumbarton Bridge was 2,953,758 vehicles, with a toll revenue of $1,169,311.80. These traffic figures compared to those of the previous year, show traffic increases of 10.2 percent and 19.2 percent, respectively, over the preceding year.

The temporary toll plaza facility at Dumbarton Bridge was improved by adding another toll lane and the installation of electronic toll collection equipment. The temporary plaza was continued in use because of the need for additional time to permit the embankment to settle at the site of the permanent toll plaza on the east approach.

The lift span operation was continued at both bridges, as required by federal law. During the year there were 2,189 lifts at the San Mateo-Hayward Bridge and 1,158 lifts at the Dumbarton Bridge.

The Division of San Francisco Bay Toll Crossings continued operations which will ultimately result in increasing the width of the San Mateo-Hayway Bridge and replacement of the lift span by a high-level structure.

Carquinez Bridge

A total of 14,104,471 vehicles used the Carquinez Bridges during the year, and $4,797,666.50 was collected. This was a traffic increase of 5.03 percent over the previous year, and a revenue gain of 4.79 percent. In January 1962, a tow service was established at the Carquinez Bridges to reduce congestion due to stalled cars and to increase safety for the motoring public.

Richmond-San Rafael Bridge

The total traffic on the Richmond-San Rafael Bridge during the year was 3,737,890 vehicles, and revenue amounted to $3,115,419.55. These figures represent increases of 7.8 percent and 7.0 percent, respectively, over the preceding year.

Two repair contracts were completed during the year, one to repair serious damage to a timber fender resulting from a ship collision, and the other to replace a prestressed concrete girder which was also damaged by collision with waterborne traffic.

The new Benicia-Martinez Bridge across the Carquinez Straits between Sonoma and Contra Costa Counties. The highest span has a 138-foot vertical clearance for navigation. The Southern Pacific Company's lift span is visible beyond.



• Personnel & Information

● *The functions of personnel, training, safety, audio-visual services and public information are grouped administratively under the direction of the engineer in charge of Personnel and Public Information*

PERSONNEL

During the past year, the total staff of the Division of Highways increased from 15,421 on July 1, 1961, to 16,017 on July 1, 1962. The engineering staff increased about 380 during this period.

On July 1, 1962, there were 8,288 engineering employees, 3,868 highway maintenance employees, 565 right-of-way employees, 478 equipment maintenance employees, and 2,818 in accounting, clerical, and other miscellaneous functions.

Recruitment

The primary emphasis again this year was on the recruitment of junior civil engineers, our beginning professional level. Some attempts have also been made to recruit at the next higher level of assistant engineer. As a result of an intensive nationwide campaign, some 200 new graduate engineers have been added to the staff. Improved recruitment procedures were introduced, including a more comprehensive followup program of job offers. In conjunction with the State Personnel Board, recruiters were sent to an even larger number of colleges than in previous years.

A more comprehensive testing program was introduced for recruiting engineering aids. These examinations are now being held on a continuous basis in all district offices so that applicants can be tested and, if qualified, put to work on a permanent basis with a minimum period of time.

Changes in accounting procedures have also necessitated additional recruitment efforts to locate professional accountants. Examination procedures were improved in highway maintenance and landscape maintenance classes.

A recently completed section of the Santa Monica Freeway in downtown Los Angeles.



Personnel Management

Major programs in the past year included putting into effect the health benefits and social security co-ordination programs passed by the 1960 Legislature. This involved furnishing comprehensive initial information on these programs to all employees and establishing systems to maintain up-to-date records.

As a part of the personnel management inventory and classification audit of the division, which is still underway by the Personnel Board, more appropriate classifications were developed for the highway maintenance series including staffing standards and levels descriptions. Improved recruitment procedures were developed to bring closer co-ordination between district and headquarters offices. Studies are underway on the landscape maintenance series and a possible right-of-way engineering series. Complete studies of all accounting departments throughout the State were conducted and a standard organization established resulting in greater use of professional accounting classes to meet the changing needs.

Salary recommendations have been made to the Personnel Board for those classes with recruitment problems or internal salary inequality problems. With the adoption of formal regulations covering employer-employee relations, a statewide program for contact with the various employees' groups was established.

During the year more than 2,000 requests for new or vacant positions were processed. Studies are still under way to establish a machine system for reporting vacancies, both for current use and future planning.

Statistics

During the year 27 employees were dismissed—5 with permanent status and 22 with temporary status. Twenty-seven were rejected during the probationary period. There were 46 disciplinary suspensions and three disciplinary demotions.

A total of 219 employees retired, bringing to 1,860 the total of those who have retired from the division.

One hundred forty-two 25-year awards were given, making a total of 2,126 since the beginning of the program.

Foreign Visitors

During the year 64 officials from 34 countries were given training and information. The greatest number of these visitors were interested in construction and laboratory procedures.

TRAINING

Formal training for Division of Highways employees is planned and organized to provide skills and knowledges directly related to division needs and job performance.

This training program, designed to meet division training needs, has included: inservice training sessions given both during state time and after working hours, job rotation, special job assignments, contracts and training agreements with academic and professional institutions, and planned self-study through the use of manuals, guides and books.

During the year 141,171 man-hours of training were conducted in orientation, supervision and management, technical and professional, safety, maintenance, and clerical.

Supervision and Management

The basic supervisory course, a 14-session 70-hour course, was given in five highway districts. A total of 295 professional engineers and right-of-way agents participated. Instructors were selected from district middle management. The basic supervisory course is designed to improve a supervisor's proficiency and develop him for future managerial assignments.

Twenty-seven of our top managers participated in the interagency management development program sponsored by the Governor's Committee on Personnel and Training. Examples of courses attended are, "executive management," "fiscal management," and "electronic data processing." Total supervisory and management training time was 30,852 man-hours.

Professional and Technical

A total of 65,684 man-hours were devoted to professional and technical training in both district and Headquarters sponsored programs. The division's professional and technical programs are attuned to recent developments and techniques. A close relationship is maintained between the division and private industry, colleges and universities, and professional associations. Examples of subjects offered during the year were: materials testing, geodimeter training, right-of-way negotiations, fundamentals of traffic engineering, and I.B.M. 1401.

The junior civil engineer rotation program is designed to give all employees hired as junior civil engineers two years of planned training experience. This year 523 engineers participated.

Special Programs

Aside from activities in the major training areas, a number of special programs were given to acquaint employees with new statewide and divisionwide procedures and policies such as SERS-OASDI co-ordination, employee appraisal and development and continuous testing program.

EMPLOYEE SAFETY

In 1950 the Division of Highways reorganized its safety program and established a Safety Section designed to develop accident prevention methods and obtain statistical information for use in prevention of industrial accidents and injuries and prevention of accidents to state-owned vehicles.

Full-time Supervisors

Safety supervisors are assigned full time in each of the 11 districts. Part-time safety supervisors are assigned the Bridge Department, State-owned Toll Bridges, Service and Supply, Materials and Research, and Equipment Departments. They investigate accidents and work methods and recommend procedures and protective devices to improve the effectiveness of the safety program. They also check on compliance with regulations relative to safety, health and fire prevention.

Safety committees function in each district, in major departments and Headquarters. The district and department committees review industrial accidents to determine appropriate action to prevent recurrence, including, when appropriate, recommendations for disciplinary action. They also review motor vehicle accidents to determine recordability and recommend action for prevention of similar future accidents.

Accidents Are Coded

Both industrial and motor vehicle accidents involving personnel or equipment of the Division of Highways are coded and annual statistical reports are prepared. The American Standards method of recording and measuring work injury experience has been adopted as the standard for the reporting and recording of accidents. Frequency and severity rates are compiled monthly and are compared to previous monthly and yearly rates to determine the effectiveness of the program.

Continuous Reduction

There has been an almost continuous yearly reduction in accident frequency in the Division of Highways since the establishment of a formal safety program. The rate has been reduced, for example, from 49.85 in 1941 to 25.59 in 1950 to 11.85 in 1961 (calendar years). This reduction in frequency has been accompanied by an increase in employees from 5,500 in 1941 to 16,017 in June, 1962.

One value of the accident prevention program is indicated by the reduction in compensation insurance

costs from $0.80 per $100 of payroll in 1945 to $0.58 per $100 of payroll in 1950 to $0.27 per $100 of payroll in 1962.

Motor Vehicle Accidents

The Division of Highways, during the calendar year 1962, generated 80,766,683 miles and had a frequency rate of 0.71. The formula used to determine frequency is the number of recordable accidents times 100,000 divided by the total mileage.

Driver training has been given to all employees who drive state-owned vehicles. New employees are given the course and have their driving record reviewed within three months of their employment. No new employee is permitted to drive a state-owned car until he has been given a road observation run by his supervisor or designated training instructor. They are required to complete the remaining part of the course, consisting of a three-hour lecture and a psychological test, within three months.

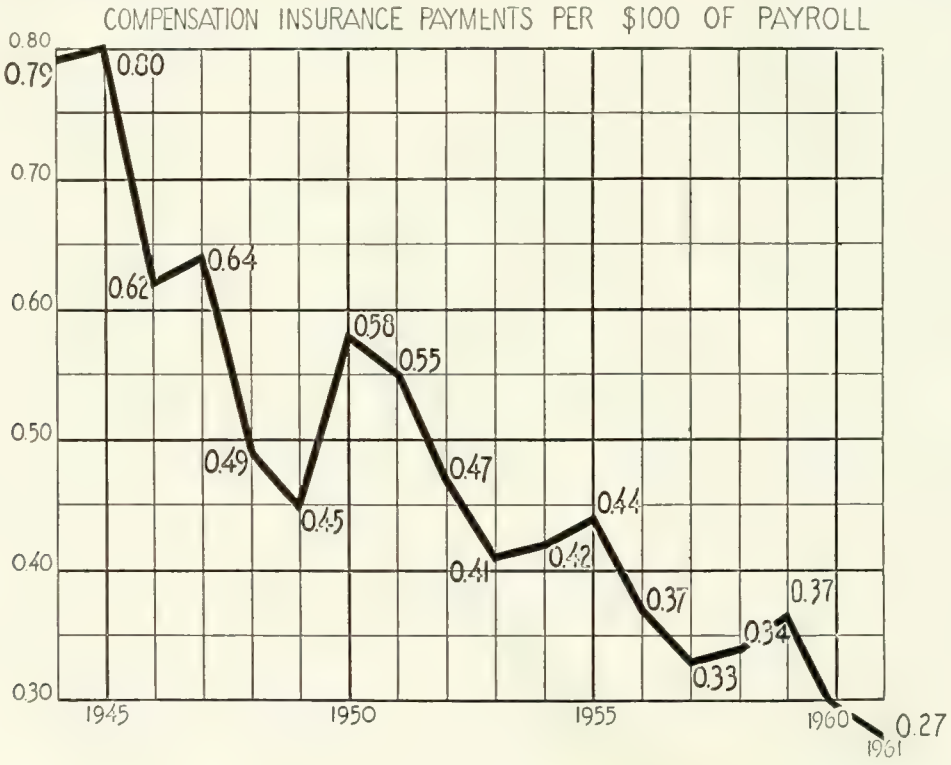
Investigations Held

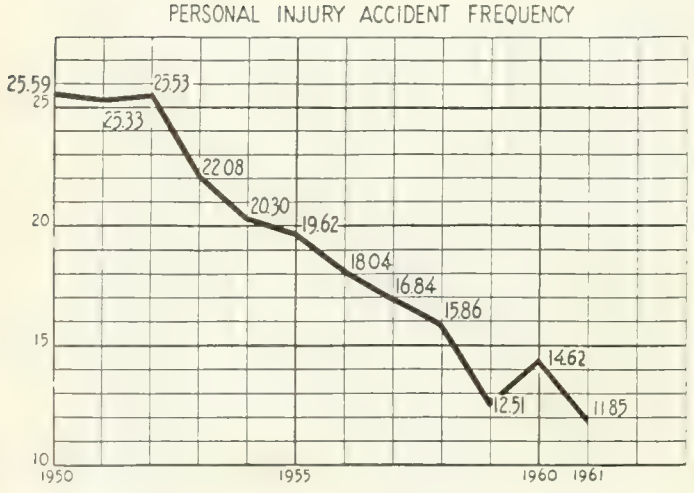
Employees who have had three or more accidents during any one year or whose driving attitude has been questioned are investigated by the district or department safety supervisor. Conferences are held with the employee and his supervisor and in serious cases are referred to the Division Safety Committee.

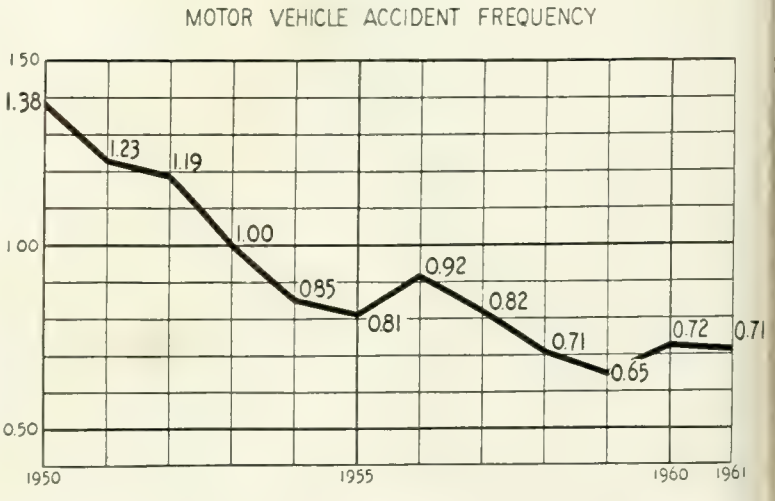
A total of 1,875 new employees completed the driver training course in 1961-1962.

Fire Prevention

Demonstrations of the use of fire extinguishers were held at various maintenance stations and employees were encouraged to use the demonstration equipment. The importance of yearly inspections of fire extinguishers was emphasized.







Employee Suggestion Program

The merit award program is co-ordinated within the Division of Highways by the Safety Section. Work on this activity for the fiscal year 1960-61 is summarized as follows:

Total No. suggestions (incl. WIP's) processed	726
Total cash awards	89
Total amount of cash awards	$3,849.00
Total No. certificates of commendation awarded	55
Total estimated savings resulting	$149,949.00

State Liability for Damage Claims

A program covering investigation of accidents where the division may be involved in damage claims is co-ordinated by the Safety Section between the districts and the Legal Department.

AUDIO-VISUAL

A wide variety of employee training and public information aids, ranging from simple graphics to booklets and reports, from posters to large exhibits and from slide presentations to filmstrips and motion pictures is produced by the Audio-Visual Section.

The section maintains a large library of colored slides on highway subjects for use in training and public information presentations, along with a variety of projection and recording equipment. In this connection, counsel is provided to district offices on the type of equipment most suitable for their needs.

Publications designed during the past year included *Report on Scenic Highways and Public Reporting for State Agencies*. Exhibits included the Highway Transportation Agency display for the State, Los Angeles County and Fresno District Fairs, and special displays for the American Road Builders Association conference in San Francisco and a scenic highways showing in Marin County.

A motion picture entitled *Freeway Documentary* was completed and is in general use. Motion pictures are also in production on *Slip Form Paving*, *Functions of the Highway Commission*, and other subjects.

PUBLIC INFORMATION

While wide interest in California's entire highway program continued during the year, special attention was focused on urban freeway development.

This interest in urban freeways was exemplified in the opening on March 30, 1962, of 23 miles of the interstate Santa Monica-Golden State Freeway Loop. It marked a major breakthrough in freeway development for the Los Angeles metropolitan area; since in effect an entirely new route, formed by portions of the two freeways, was added to the metropolitan network.

Of special significance was the fact that an alternate bypass facility skirting the fringes of downtown Los Angeles and more or less paralleling the existing Hollywood Freeway became a reality.

Information on openings such as this and other events was furnished to communications media, and both routine and special news releases were used extensively. Many inquiries by specialist writers were answered and a large number of photographs were made available.

Hundreds of thousands of Californians viewed freeway exhibits, not only at the State Fair in Sacramento, but also, for the first time, at the Los Angeles County Fair at Pomona and at the Fresno District Fair. The 1962 exhibit was a co-operative effort of the three departments (Public Works, Highway Patrol, Motor Vehicles) comprising the Highway Transportation Agency.



Seedlings for use in freeway landscaping are transplanted at the nursery in the Riverside maintenance yard.

The highways portion included color photographs illustrating freeway design features contributing to traffic safety, and also a freeway scale model. At Sacramento and Fresno the model was the one showing the future Interstate Freeway through the west end of Sacramento, and the surrounding city redevelopment and proposed historical area; at Pomona the model was that of the recently completed four-level U.S. 101-395 interchange in San Diego.

The Division of Highways joined other highway departments throughout the nation in observing National Highway Week May 20-26, as proclaimed by President Kennedy and supported in a statement by Governor Brown. There were luncheons and tours arranged by local civic groups. The various districts co-operated with news media in presenting the highway picture on the local level.

Publications

The bimonthly magazine *California Highways and Public Works* continued as the principal publication of the Department of Public Works and the Division of Highways. While its main



A landscaped section of the Golden State Freeway in the Griffith Park area of Los Angeles.

distribution is in California to employees of the division and other interested persons, there was a growing demand for it in other states and foreign countries. Numerous articles from the magazine were reprinted and many photographs were furnished to editors and writers for foreign and domestic publications.

Public information material issued in published form included, in addition to regional material prepared by the various districts:

"California Highways—1961," a 12-page illustrated reprint from *California Highway and Public Works* magazine constituting a concise, nontechnical version of the division's annual report.

"California's Freeway Planning Team," a leaflet prepared principally for the use of legislators and public service organizations in explaining highway planning procedures.

"California Roadsides," a 38-page reprint of four articles on landscaping and functional planting which appeared in *California Highways and Public Works.*

"Freeway Facts," an illustrated booklet containing basic information about freeways and route adoption procedures, widely used at district public meetings (revised in May 1962).

Reprints of articles and district roundups published in *California Highways and Public Works,* used as informational mailing pieces to answer a wide range of inquiries.

"Clip Sheet," which provides information for use in employee publications issued by each district and some headquarters departments.

"Report to the Governor," a monthly summary of important developments in the work of the Department of Public Works, intended for the information of department heads in state governments and the press.

News releases on routings considered and acted on by the California Highway Commission totaled 146 during the fiscal year, of which 42 were accompanied by maps specially prepared for newspaper reproduction. This was in addition to previous extensive publicity given to route hearings at the district level. Due advance publicity was given seven public hearings scheduled by the commission.

Other News Releases and Media Contacts

The quantity and scope of news releases issued by the division continued to increase, especially on the part of the district offices. A large number of photographs of highway projects were supplied to newspapers and magazines on request, particularly on major freeway projects.

Information on the highway program was also issued through telephone calls, office interviews, correspondence and appearances by division personnel on radio and television programs, and before local civic organizations and service clubs.



A maintenance crew repairs a section of median barrier fence on the San Bernardino Freeway.

• Right-of-Way

• *The Right of Way Department appraises and acquires property required for state highway purposes, manages such property in the preconstruction period and arranges for the removal or relocation of improvements and utility facilities to clear the right-of-way. It also handles appraisals, negotiations and purchases for the Department of Water Resources and the State Public Works Board. The number of people working in right-of-way classes during the year averaged 547.*

During the 1961-62 fiscal year the Right of Way Department completed a new record total of 10,178 property transactions involving an expenditure of $160,505,567.81. Of these transactions 9,081 involved acquisitions for highway right-of-way, 775 were for utility relocation and 322 for other uses such as for state agencies. The distribution of the total expenditures is as follows:

Highway right-of-way	$141,497,225
Utility relocation to clear highway right-of-way	10,315,502
Acquisition other than right-of-way (primarily land purchased for other state agencies)	8,692,839

Acquisition Policy

The acquisition procedure allows all owners sufficient time to consider the settlement offer and make arrangements to relocate. A request for resolution of condemnation is not presented to the California Highway Commission until it is clear that a reasonable time for deliberation and decision has been afforded the property owner. Despite pressures of meeting construction schedules, it is imperative to allow sufficient time for the determination of fair market value through the appraisal and negotiation process. In addition, enough notice must be given to assure that persons displaced by highway projects will have adequate time to find a reasonably comparable place in which to relocate.

The effectiveness of the long-standing policy of providing adequate time for appraisal, negotiation and relocation to protect the interest of the property owner, as well as of the State is evidenced by the ratio of negotiated settlements to contested court cases. During the fiscal year, of the 9,081 parcels acquired only 244 or 2.7 percent were obtained through contested eminent domain proceedings.

Relocation Counseling

Time, however, is not alone sufficient to facilitate smooth relocation.

With the completion of the Santa Monica Freeway Viaduct between the Santa Ana and Harbor Freeways, vast parking areas were made available to the public under the structure.



In order to assure adequate relocation with the least inconvenience to those displaced, a counseling service is provided for those who need assistance in the location of new facilities.

Land Management and Utility Relocation

This phase of the department's operation included the leasing of 6,551 properties during the interim period between acquisition and clearance of rights-of-way and also included the sale of improvements and excess properties. The fiscal year produced a gross return to the State Highway Fund of $12,081,509.

Airspace Rights

Recently enacted federal regulations allowing the use of air space on interstate highways by state governments will have an important effect on growth and development in metropolitan areas. The new regulations, which apply to all highways built with federal funds, include most of the major freeways recently completed or under construction in California. They open up a whole new potential field of construction of public buildings, hotels, apartments, stores and recreational facilities either straddling below-ground freeway sections or set beneath viaduct areas.

The Department of Public Works has for many years leased open-air areas under freeway structures for parking and storage, as permitted under prior legislation. These leases have been on a competitive bid basis.

Excess lands required for right-of-way purposes are returned to private ownership and tax rolls as soon as possible. During the year 974 parcels of excess land were sold or exchanged. These excess parcels were originally acquired to avoid payment of excessive damages or because the remainders were too small or irregularly shaped to be developed economically as individual parcels. The department has combined many small and irregularly shaped parcels and by this process has returned many desirable sites to public use.

Relocation of utility facilities for proposed highway construction is the responsibility of the Right of Way Department. Relocation costs have increased appreciably in the past 15 years. During this year 775 state utility-owner transactions for relocation totaled $24,653,977.

Personnel

The major problem of the Right of Way Department in accomplishing its extensive land acquisition program is still the serious shortage of experienced personnel with knowledge and abilities in four major fields: appraising, acquisition, property management and economic analysis of data concerning community development.

During this year the department lost 48 experienced agents or approximately 9 percent of its total personnel. This percentage loss has been constant for the past five years. Since it takes about three years for even the most qualified new agent to attain the associate or journeyman level, the department has been forced to maintain a constant and intensive training program for new personnel. During 1961-62 more than 20,000 classroom and home-study hours were devoted to right-of-way instruction. This includes attendance at colleges and universities as well as instruction by staff members.

Land Economic Studies

The Land Economic Studies Section, recently redesignated as the Research and Development Section, performs basic functional and operational research for the Right of Way Department in order to furnish material for public guidance, improve the accuracy of the appraisal process, permit the relation of engineering factors to public requirements, and increase the effectiveness of negotiations. During the year the section assignments included:

1. *Special Economic Studies*

These studies deal with the relationship of engineering factors with the community effects of freeway construction. For example, the section produced "King City—Economic Effects Analysis of Alternate Bypass Route Proposals" and "Crosstown Freeway in the City of Stockton—An Examination of the Possible Effect of Selected Economic Factors on Freeway Design and Construction."

In addition, investigation of what happens to people, homes and businesses displaced by freeways was continued. It is expected that in the near future significant data will be available which will give a comprehensive picture of displacement patterns.

2. *Operational Studies*

These studies involve the use of objective measures to investigate and standardize right-of-way practices in order to be able to predict and control lead time and staffing requirements and to improve management techniques. This is a continuing study involving statistical analysis of the variations of more than 10,000 parcels acquired annually.

3. *Special Studies*

During the year the section compiled many special studies involving many diverse subjects, e.g., "Practical Liaison at Work," "Excess Lands – California's Concept and Conduct of Marginal Land Acquisition" and "The Importance of Lead Time."

4. *Remainder Parcel Studies*

These are continuing studies which deal with property from which a portion was acquired leaving a remainder outside the right-of-way limits. After analysis of about 1,000 parcels during the year this project was turned over to the Appraisal Section as a continuing appraisal project.

• Legal

• *The Division of Contracts and Rights of Way is the legal division of the Department of Public Works and renders a variety of legal services to the department and its Division of Highways*

Some idea of the volume of the condemnation casework is given by the following tabulation. (The parcel count is based on a count of parcels in condemnation resolutions.)

Suits filed	516
Parcels involved	2,310
Defendants involved	11,998
Suits closed	312
Contested trials	247
Uncontested judgments	216
Default judgments	21
Suits pending 7/1/61	684
Suits pending 6/30/62	888

There was a further increase in suits filed as compared to the previous fiscal year—a 12⅔-percent increase from 458 to 516. The total suits closed, 312, represented total awards of $14,395,400.37 and represented 1,513 days in court.

Appellate Cases

During the fiscal year many appellate court briefs were written by the division and appeals argued. Decisions were rendered in *International Oil and Metal Corp.* v. *State of California*, 204 A.C.A. 617 (22 Cal. Rptr. 568); *Zeppi* v. *State of California*, 203 A.C.A. 410 (21 Cal. Rptr. 534); *Arques* v. *State of California*, 199 A.C.A. 246 (18 Cal. Rptr. 397); *People* v. *Forster*, 199 A.C.A. 386 (18 Cal. Rptr. 828); *People* v. *Logan*, 198 A.C.A. 607 (17 Cal. Rptr. 674); *Barry* v. *Department of Public Works*, 199 A.C.A. 380 (18 Cal. Rptr. 637); *Stafford* v. *Department of Public Works*, 195 Cal. App. (2d) 148 (15 Cal. Rptr. 402); *People* v. *Neider*, 195 Cal. App. (2d) 582 (16 Cal. Rptr. 58); *People* v. *Dittmer*, 193 Cal. App. (2d) 681 (14 Cal. Rptr. 560); *Reid* v. *State of California*, 193 App. (2d) 799 (14 Cal. Rptr. 597); *People* v. *Podrat*, 194 Cal. App. (2d) 696 (15 Cal. Rptr. 343); *People* v. *Donovan*, 57 A.C. 374 (19 Cal. Rptr. 473); *Sinclair* v. *State of California*, 194 Cal. App. (2d) 397 (15 Cal. Rptr. 493); *Flournoy* v. *State of California*, 57 A.C. 538 (20 Cal. Rptr. 627).

In the case of *International Oil and Metal Corp.* v. *State of California* the Third District Court of Appeal affirmed the granting of a motion for summary judgment in favor of the State. The court held that the Division of Highways was a bona fide purchaser of right-of-way for value since the plaintiff corporation had not filed a certificate of merger as required by law prior to the time of the purchase by the State.

In *Zeppi* v. *State of California* the appellate court reversed the granting of a motion to vacate a judgment in favor of the State. The appellate court held that the *Muskopf* decision, which overturned the long-standing doctrine of sovereign immunity, was not a reason for relieving the plaintiff from the dismissal of his action on the grounds of mistake.

The case of *Arques* v. *State of California* involved an action for inverse condemnation against the Division of Highways. The appellate court affirmed the trial court's finding that the division was not responsible for decreasing the water depth over the claimant's land, allegedly caused by deposits of fill which were washed down into the bay during construction of a freeway.

The case of *Barry* v. *Department of Public Works* involved the right to acquire park property for highway purposes. The court held that Section 103.5 of the Streets and Highways Code clearly allowed the Highway Commission to acquire park property for highway purposes when it determined by resolution that necessity existed. The court further held that the question of necessity was not subject to judicial review.

In *Reid* v. *State* the plaintiff sought to enjoin the Division of Highways from constructing a service road across his property in connection with

BELOW LEFT, the freeway bypass of the City of Dunsmuir in the Sacramento River Canyon. Mount Shasta is in the background. BELOW RIGHT, an aerial view of the freeway between Healdsburg and Santa Rosa in Sonoma County while it was under construction.





the reconstruction of an expressway to a full freeway. The district court affirmed the dismissal of the complaint for the reason that the question of necessity for the condemnation of property for highway purposes was not subject to judicial review and the Division of Highways had the right to construct the service road as a part of the freeway.

In the case of *Sinclair* v. *State* the district court of appeal held that Section 90 of the Streets and Highways Code (authorizing the department to lay out and construct state highways) was not unconstitutional since it was a sufficient and definite guide to the Highway Commission in the exercise of powers conferred upon it by the Legislature. The court also said that the decisions of the Highway Commission were quasi-legislative and not quasi-judicial. Therefore, they were not subject to judicial review because of an alleged abuse of discretion.

Several other cases are pending before the Supreme Court and the various district courts of appeal, awaiting argument or decision.

Other Litigation

In addition to the condemnation proceedings, the department's attorneys handled a large number of miscellaneous cases. The following tabulation covers a wide variety of litigation and indicates the continuing increase in this aspect of the department's work.

At the start of the fiscal year there were 718 cases pending; 475 cases were filed during the year, for a total of 1,193 cases being processed. There were 509 cases closed during the year, with 684 cases pending June 30, 1962.

Some of these cases involve claims for damage to state highway facilities, such as bridges, signals, guardrails, or damage to state vehicles, or unlawful detainer actions. During the fiscal year collections from these cases by the division amounted to $83,767.85.

The case total includes many cases where the department was represented as a defendant, such as inverse condemnation, suits by contractors for additional compensation on construction contracts, proceedings for damage to public property by reason of state highway operations, suits filed because of alleged dangerous or defective condition of state highways, and suits against the State and its contractors enjoining the construction of highways. Other types of suits, such as stop-notice actions, are defended by the department, and the department has filed interpleader actions in which it assumes a neutral position between the contractor and the party suing on a stop notice.

Proceedings Before P.U.C.

The division handles matters before the Public Utilities Commission having to do with crossings of grade at highways and railroads and the construction of grade separations. The following tabulation indicates the volume of work handled by the division in this category:

Applications pending 7/1/61	13
New applications filed	23
Total applications before P.U.C.	36
Decisions received	25
Applications pending 6/30/62	11

Also, 14 proceedings under P.U.C. General Order 88, relating to crossings at grade, were processed. In all instances the approval of the Public Utilities Commission must be obtained as to engineering details and, in the event of a failure to reach an agreement with the railroad involved as to apportionment of cost, the applicant seeks such determination by the P.U.C. The enactment by the Legislature of a new formula for apportionment of cost, except for federal-aid highways, has substantially reduced the number of contested cases.

Board of Control and Other Claims

Claims against the state by reason of activities of the department are filed with the State Board of Control. The following tabulation illustrates the increase in the volume of work handled by the department's attorneys before the Board of Control:

	Number of claims	*Amount of claims*
Pending on 7/1/61	96	$4,734,960.09
Filed	278	11,861,539.25
Total	374	$16,596,499.34
Claims disposed of	272	8,379,402.54
Pending 6/30/62	102	$8,217,096.80

There was an increase of 85 claims filed over the previous year, amounting to $4,686,375.13. This was an increase of 44⅐ percent. The principal types of Board of Control claims as listed above are for negligence, dangerous or defective condition of state highways, breach of contract and inverse condemnation.

Other claims filed with the department and its employees and the Governor number 38.

The increased number of claims filed with the board is due mostly to the recent decision by the California Supreme Court in the case of *Muskopf* v. *Corning Hospital District*, 55 Cal. (2d) 211. This decision greatly expanded the liability of the State, particularly for accidents arising out of the dangerous or defective conditions of state highways. The 1961 session of the Legislature enacted Chapter 1404 which placed a moratorium until 90 days after the end of the 1963 session in which suits could be brought against the State. This legislation still permits the filing of claims against the State, but postpones the actual litigation. This enactment will necessitate the careful investigation by Division of Highways personnel of all claims. It is anticipated that because of the *Muskopf* decision the number of claims will increase, as well as the work involved in handling them.

Contractors' claims before the State Highway Engineer's Board of Review for additional compensation have increased notably. These claims have required considerable work, both in analysis and handling claims and in resulting litigation. Directly proportional to the number of Board of Review hearings is the increased number of lawsuits against the department arising out of construction contract claims.

House Counsel Work

The "house counsel work" of the division has also shown a decided increase. This work consists of legal opinions directed toward *preventing* litigation.

Other routine work has increased, such as approval of contracts and leases, reviewing forms and accident reports. This work is directly proportional to the increased volume of the highway program. In addition, there were 25 contested hearings before the State Personnel Board, an increase of 19 over the previous fiscal year.

• Fiscal • Management

• *Administration of all accounting activities of the Division of Highways is under the direction of the Comptroller of the Division of Highways and his staff*

On June 30, 1962, cash and securities on hand amounted to $112,302,475, of which $92,682,040 was invested in U.S. government securities. On the same date, the outstanding obligations in the form of uncompleted construction contracts and day labor jobs, including $112,787,602 in contracts financed from the ensuing fiscal year budget, were $362,013,274, of which $162,680,098 is financed from federal-aid funds and $5,687,420 by local political subdivisions, state agencies, and others. The remaining $193,645,756 represents obligations of the State Highway Fund as of June 30, 1962. However, the financing of the obligations is subject to change as additional federal funds become available, and as redeterminations are made of the participating agencies' shares of the cost.

Revenue and Expenditures

Revenues budgeted for the 1961-62 fiscal year amounted to $645,833,641, of which $230,938,931 remained to be collected on June 30, 1962. Revenue not received, which consists of $222,560,154 of federal aid and $8,378,777 of contributions from state and local agencies and other sources, will be collected as applicable work is completed or billed. Revenues budgeted for the prior fiscal year amounted to $597,593,268, the increase in the 1961-62 fiscal year being due primarily by a larger apportionment of federal funds.

Expenditures and obligations incurred applicable to the fiscal year ended June 30, 1962, amounted to $615,605,477, as compared to $676,123,729 for the prior fiscal year. As revenue budgeted exceeded obligations incurred by approximately $30,000,000, the unobligated budget funds increased from $83,871,163 on June 30, 1961, to $116,405,717 on June 30, 1962.

Accounting Procedures

The accounting system and procedure for highway property rental income in which political subdivisions participate was changed considerably during the year because of the enactment of Chapter 1260, Statutes of 1961, amending Sections 104.6 and 104.10 of the Streets and Highways Code. The statute now provides that, instead of all of such rentals being deposited in a separate fund for subsequent distribution, the State's share of 76 percent shall be retained in the State Highway Fund. This change in the law resulted in the immediate transfer of more than $4,000,000 in

Work progresses on the U.S. 99 freeway bypass of Modesto in Stanislaus County.



prior collections to the State Highway Fund and the retention of 76 percent of current collections, which aggregate approximately $2,500,000 a year, in the Fund.

The form of contract payment vouchers was revised to permit easier preparation and more expeditious handling.

Chapters 1, 2 and 3 of the *Accounting Manual* were brought up to date. Revised charts of accounts were published in connection with the revised chapters.

End-of-year closing instructions were revised to accommodate changes caused by adoption of electronic data processing for certain accounting procedures.

Procedures for authorizing and accounting preliminary engineering expenditures were improved, in co-operation with the engineering staff, to become operative in the 1962-63 fiscal year. Features of the new procedure include segregation of advance planning and design costs in the control and subsidiary accounts, an improved project numbering system, and the elimination of interoffice transfer of charges relating to fund allotments.

Fiscal Management Organization

During 1962, all district accounting offices have adopted a uniform organization plan developed by Headquarters Fiscal Management and Personnel Departments. This plan changes the title of the heads of the district accounting departments from chief clerk to chief accounting officer and increases the professional accounting staff in the district offices. Nonaccounting functions have been removed from district accounting departments. Accounting functions previously performed elsewhere in some districts, such as co-operative project accounting, or right-of-way rental accounting, have been transferred to district accounting departments. These changes in personnel classifications and functional alignment should lead to improved performance of the accounting function and enable the district accounting departments to furnish more meaningful reports to district engineers in time to be of value in current operations.

Headquarters Fiscal Management has established a new unit to audit relocation billings of railroads and public utilities. When projects with federal participation are being audited, the salaries and expenses of the audit personnel will be reimbursed by the federal government.



The south end of the Harbor Freeway in Los Angeles looking toward the harbor area in San Pedro.

The staff working on the "concurrent audit" project has been increased to fulfill the requirements for acceptance of this program by the Bureau of Public Roads.

Electronic Data Processing

Effective July 1, 1961, expenditure cost analysis records were placed on a data processing system. The initial entry into data processing covered an analysis of costs as to location (district, county, route, and section), source (who did it), activity (what was done), and object of expenditure. The Systems and Procedures Unit, in co-ordination with the Data Processing Center, is developing programs, for the 1401 computer, to produce expenditure analysis and management reports. Reporting will show project costs and provide, for comparative purposes, cost analyses as to functions.

As with all new data processing installations, problems have been encountered. Commencing in March 1962, regular meetings were held between personnel of the Data Processing Center and Headquarters Fiscal Management. These joint discussions have led to many improvements, including the introduction of consistency checks for cost distribution codes.

Both Headquarters and district accounting personnel are being trained in data processing. A pilot program for district chief accounting officers is planned. Selected Headquarters accounting personnel have had limited data processing training.

1963-64 Budget

Proper Balance Between Interstate, Noninterstate Road Needs Is Goal

The California Highway Commission on October 19 adopted a record $695,927,042 state highway budget for the 1963–1964 fiscal year.

The budget contains $554,677,084 for state highway construction purposes, including rights-of-way.

The previous budget, adopted in October 1961, contained an overall total of $658,370,017, of which $527,792,917 was for construction purposes.

State Director of Public Works Robert B. Bradford, Commission Chairman, said the budget is up from last year as a result of increases in federal apportionments for the interstate system in California and in estimated revenue from state highway user taxes.

A total of $305,606,000 in federal funds has been allotted to California for 1963–64, including $247,917,800 for work on interstate highways. The corresponding totals for 1962–63 were $286,631,017 and $228,847,200.

State Revenue Up

Estimated revenue from state sources is up about $13,700,000, most of it from highway user taxes on gasoline and diesel fuel, indicative of the continuing increases in travel mileage by the State's motorists and truckers.

The budget provides funds for 218 projects including construction of 267 miles of multilane freeway, 31 miles of multilane expressway, 23 miles of two-lane expressway (planned for future expansion to four lanes divided), and widening 26 miles of existing freeways.

"This budget," Bradford said, "represents a conscientious effort to balance the construction progress on the national interstate highway system, for which substantial funds are committed by the federal government, with the most urgent needs on the noninterstate routes.

"The commission has tried, as always, to get the most in traffic safety and efficiency in every corner of the State out of every available dollar. If additional funds turn up from any source, including favorable bids, we will be prepared to put them to work in the form of additional construction projects without delay."

Major sources of state-collected highway revenue expected for 1963–64 include $282,736,000 in gasoline taxes; $60,308,000 in motor vehicle fees; $25,300,000 from the use fuel (diesel) tax; $13,850,000 from transportation taxes on for-hire carriers; and interest on investments and deposits, $3 million (up $300,000).

The budget contains $63,777,958 for functions other than state highway work.

The largest non-state-highway item is $38,142,708 for major city streets, based on five-eighths cent per gallon of the state gasoline tax. Other non-state-highway items are:

Federal aid for county roads on the federal aid secondary system, $8,884,750; state funds to counties for use in matching these federal funds, $4,350,000; state funds to help finance railroad grade separation projects on local streets and roads, $5,000,000; engineering funds to cities, $1,350,000; and state funds to pay part of the cost of urban extensions of FAS county roads, $1,050,500.

Portion for County Roads

Bradford pointed out that California's 58 counties receive 1⅜ cents per gallon from the State's 6-cent-per-gallon gasoline tax, plus a portion of the motor vehicle fees. These funds are disbursed directly by the State Controller and are not listed in the State Highway Budget.

For the 1963–64 fiscal year, these state-collected funds for county roads will total an estimated $98,600,000.

The $554,677,084 in the budget for highway construction purposes includes:

Major construction and improvement (including engineering), $384,660,000; rights-of-way, $156,017,084; contingencies, $6,000,000; resurfacing program, $5,000,000; signs and striping, $2,000,000; and minor improvements, $1,000,000.

Proposed expenditures for state highway purposes other than construction include: maintenance, $49,000,000; buildings and plants, $9,000,000; administration, $12,075,000; statewide highway planning survey, $3,400,000; maintenance of state toll bridges, $2,750,000; and honor camps, $1,100,000.

The 1963–64 budget contains 28 landscaping and other planting projects, including trees, for which $3,176,000 is budgeted.

1963-64 State Highway Budget Projects by Counties

Note 1. Construction contracts may be awarded beginning January 1963. Right-of-way funds may not be spent until July 1, 1963 (start of the fiscal year).

Note 2: Projects which overlap county lines are listed in both counties.

Note 3: The term "freeway" means a multilane divided highway with full access control, no crossings at grade, no stoplights and no left-turn movements. As used here, an "expressway" is a multilane divided highway with most full freeway features except that traffic may cross at grade at some intersections. "Two-lane expressway" is a two-lane highway with some measure of access control, usually planned for future expansion to four lanes divided.

Route	Description	Approx. mileage	Estimated cost
	ALAMEDA COUNTY		
US 50 (Interstate 5W)	Landscape MacArthur Freeway between Park Boulevard and Buell Street in Oakland	2.9	$360,000
US 50, SSR 24 (Interstate 5W)	Portion of interchange between MacArthur and Grove-Shafter Freeways in Oakland	0.5	6,235,000
SSR 24	0.75 mile of 8-lane freeway and portions of the interchange between State Sign Route 24 and the Warren Freeway in Oakland	1.5	3,750,000
SSR 21 (Interstate 680)	6-lane freeway between 0.4 mile south of US 50 and 1 mile north of the Alameda-Contra Costa county line	3.0	7,500,000
SHR 227	Landscape Warren Freeway at the Moraga Avenue Interchange in Oakland	0.5	45,000
FAS 1030 Urban Extension	Widen Redwood Road to 4 lanes between Joseph Drive and Reyer Avenue in Hayward area. (Urban extension of federal aid secondary county road. Alameda County's share, $150,000)	0.4	150,000 (State's share)
FAS 1031 Urban Extension	Widen Lake Chabot Road to 4 lanes between Keith and Carlton avenues in Hayward area. (Urban extension of FAS County Road. Alameda County's share, $140,000)	0.7	140,000 (State's share)
Various	Rights of Way (includes $5,500,000 for US 50 Freeway in San Leandro-Castro Valley area and $6,500,000 for Grove-Shafter Freeway in Oakland)		16,375,000
	ALPINE COUNTY		
SSR 88	Resurface between Amador county line and Carson Pass Summit	5.3	180,000
Various	Rights of Way		30,000
	AMADOR COUNTY		
SSR 49	Reconstruct and widen between Calaveras county line and 1.3 miles north	1.3	850,000
Various	Rights-of-way		90,000
	BUTTE COUNTY		
US 99E	4-lane freeway between Centerville Road and Big Chico Creek in Chico	2.6	2,300,000
US 99E	Landscape and tree planting between East Ninth Street and East First Avenue in and near Chico	1.1	95,000
US 40 Alt.	Tree planting between south of the South Oroville Separation and Wicks Corner	6.5	10,000
Various	Rights-of-way		360,000
	CALAVERAS COUNTY		
SSR 4	Widen between Ganns Meadow and 5.5 miles east	5.5	1,050,000
SSR 49	Pave between State Sign Route 12 north of San Andreas and Mokelumne Hill. (Grading and structures under way)	6.5	600,000
Various	Rights-of-way		200,000
	COLUSA COUNTY		
Various	Rights-of-way		550,000
	CONTRA COSTA COUNTY		
SSR 21 (Interstate 680)	6-lane freeway between 0.4 mile south of US 50 and 1 mile north of the Alameda-Contra Costa county line	3.0	7,500,000
Various	Rights-of-way		1,410,000
	DEL NORTE COUNTY		
US 101	Clear and grade for ultimate 4-lane freeway between 0.9 mile south of the Del Norte county line and 1.1 miles south of Klamath	5.0	4,100,000
Various	Rights-of-way		350,000
	EL DORADO COUNTY		
US 50	Tree planting between Fairgrounds Interchange and Placerville	1.9	5,000
US 50	Widen to 4 lanes and improve alignment between 1.6 miles east of Placerville and 0.3 mile west of Five Mile Terrace	1.7	420,000
US 50	4-lane freeway between 0.3 mile east of Camino and 1.1 miles east of Sly Park Road	6.6	4,590,000
SSR 49	Widen between 0.8 mile south of Greenwood Creek and 0.4 mile north of South Fork of American River	1.5	170,000
Various	Rights-of-way		320,000
	FRESNO COUNTY		
SSR 41	2-lane expressway between North Fork of Kings River and 0.1 mile north of Elkhorn Avenue in Fresno County, with a 1 mile 4-lane freeway section at the Excelsior Avenue Interchange at the Kings-Fresno county line	7.2	2,050,000
FAS 564 Urban Extension	Widen Dinuba Avenue from 2 to 4 lanes between Frankwood Avenue and the east city limit of Reedley, and install automatic warning signals at railroad crossing. (Urban extension of FAS county road. Reedley's share, $116,000)	0.6	116,000 (State's share)
FAS 823 Urban Extension	Widen Frankwood Avenue between Stanley and Dinuba Avenues in Reedley. (Urban extension of FAS county road. Reedley's share, $20,000)	0.5	20,000
Various	Rights-of-way		3,049,000

Route	Description	Approx. mileage	Estimated cost
	GLENN COUNTY		
SHR 45	Widen between 1 mile and 0.5 mile west of the Glenn-Butte county line	0.5	$200,000
Various	Rights-of-way		215,000
	HUMBOLDT COUNTY		
US 101	Clear and grade for ultimate 4-lane freeway between 0.9 mile south of the Del Norte county line and 1.1 miles south of Klamath	5.0	4,100,000
US 101	Widen bridge across Bear Gulch north of Garberville and realign approaches	0.4	75,000
US 101	Planting, including trees, between Eureka and Arcata		25,000
US 101	4-lane freeway between Mad River and 0.2 mile north of Little River	7.9	4,950,000
US 101	Widen and resurface between 3.2 and 6.4 miles north of Arcata	2.7	65,000
SSR 36	Widen and improve alignment between 1.1 miles east of Hydesville and 0.5 mile west of Carlotta	0.7	220,000
SSR 36	Widen portions and ease curves between 1.3 and 10 miles east of Bridgeville	1.0	100,000
SHR 56	2-lane expressway between Van Ness Avenue in Ferndale and 0.5 mile south of Fernbridge	3.3	850,000
Various	Rights-of-way		840,000
	IMPERIAL COUNTY		
US 80 Interstate 8	Two eastbound lanes between the San Diego county line and State Sign Route 98, making this section a 4-lane freeway (westbound lanes under construction	9.7	3,000,000
US 80 Interstate 8	Replace bridges over Westside Main Canal and Bullhead Slough in and east of Dixieland		150,000
US 99	Widen to 4-lane city street between Third Street and Birch Street (State Sign Route 98) in Calexico	0.8	200,000
SSR 111	Widen between Brawley and Calipatria	9.5	110,000
Various	Rights-of-way		1,197,000
	INYO COUNTY		
US 6	Extend abutments and replace decking on bridge across Upper McNally Creek, north of Bishop		20,000
Various	Rights-of-way		20,000
	KERN COUNTY		
US 99 Interstate 5	Convert 4-lane expressway to 8-lane freeway between just north of Los Angeles county line and Fort Tejon	4.7	2,900,000
US 99 Interstate 5	Truck shelter and tool room at Wheeler Ridge Scale and Brake Inspection Station		104,000
US 99	Planting, including trees, on portions between 1 mile south of Sherwood Avenue in McFarland and Kings River in Tulare County		125,000
SHR 141	Widen Brundage Lane to 4 lanes between Union Avenue and Oak Street in Bakersfield	2.0	560,000
SHR 142	Widen portions between 1.6 miles west and 8 miles east of Glennville	9.6	100,000
US 466	Grade for future 4-lane freeway between 0.5 mile east of Keene and 0.8 mile west of Tehachapi Overhead	7.6	4,100,000
Various	Rights-of-way		2,498,000
	KINGS COUNTY		
SSR 198	4-lane freeway and expressway between 0.3 mile west of State Sign Route 41 and 11th Avenue in Hanford; reconstruct Third and Fourth Streets to 10th Avenue as a one-way couplet; connection on 10th Avenue to the existing highway	10.4	4,650,000
SSR 41	2-lane expressway between North Fork of Kings River and 0.1 mile north of Elkhorn Avenue in Fresno County, with a 1 mile 4-lane freeway section at the Excelsior Avenue Interchange at the Kings-Fresno county line	7.2	2,050,000
Various	Rights-of-way		470,000
	LAKE COUNTY		
SSR 29	Replace bridge across Putah Creek north of Middletown on new alignment and construct approaches	0.6	200,000
SSR 29	Replace bridges across McGough Slough, Adobe Creek and Hill Creek and extend eight culverts between McGough Slough and Ackley Road near Kelseyville		150,000
SHR 243	Replace bridge across Seigler Creek west of Lower Lake		25,000
Various	Rights-of-way		50,000
	LASSEN COUNTY		
US 395	2-lane expressway between Mesa Street in Susanville and a mile southeast of Johnstonville	4.8	1,030,000
Various	Rights-of-way		20,000
	LOS ANGELES COUNTY		
US 101	Landscape portions of Hollywood Freeway between 0.2 mile southeast of Moorpark Street and Magnolia Boulevard	1.1	135,000
US 101	Install additional signs on Ventura Freeway between San Diego Freeway and Encino Avenue		70,000
US 101	Convert 4-lane Ventura Freeway to full freeway between west city limit of Los Angeles and Las Virgenes Canyon Road		1,200,000
US 101	Convert 4-lane Ventura Freeway to full freeway between 0.3 mile west of Las Virgenes Canyon Road and 0.4 mile southeast of Chesebro Road Overcrossing at Agoura		690,000
US 6-99 Interstate 5	Widen portions of Golden State Freeway to eight lanes between 0.2 mile south of Western Avenue in Glendale and 0.2 mile north of Alameda Avenue in Burbank	0.7	135,000
US 99, SSR 126 Interstate 5	8-lane US 99 Freeway between 0.9 mile south of Santa Clara River and 0.4 mile north of Castaic Interchange, and 4-lane SSR 126 Freeway from US 99 to 0.8 mile westerly	4.5	5,950,000
US 99 Interstate 5	Improve drainage facilities at Marple Canyon about 4.5 miles north of Castaic		95,000
US 99 Interstate 5	Seal coat between 2.0 and 12.7 miles north of Castaic	10.7	150,000
SSR 118	Widen portions of Devonshire Street to four lanes between Topanga Canyon Boulevard and DeSoto Avenue in Chatsworth area in Los Angeles. (City's share, $191,000	1.0	130,000 (State's share)
SSR 118	Widen Devonshire Street to four lanes and install traffic signals and highway lighting between Zelzah Avenue and Sepulveda Boulevard near San Fernando	3.2	515,000
SSR 118	Widen Foothill Boulevard to four lanes between Vaughn and Fenwick Streets in Sunland area	5.5	950,000
SSR 118	Reconstruct roadway on Lincoln Avenue between Canada and Forest Avenues in Pasadena	0.9	70,000
US 6	4-lane Antelope Valley Freeway between 0.5 mile west of Red Rover Mine Road and 0.5 mile north of Angeles Forest Highway near Vincent	7.9	5,300,000
SSR 138	Reconstruct shoulders of Pearblossom Highway between 57th Street East, west of Little Rock, and Palmdale-Victorville Road east of Llano	17.8	200,000

Route	Description	Approx. mileage	Estimated cost
	LOS ANGELES COUNTY—Continued		
US 101 Alt.	Reconstruct shoulders and surface Pacific Coast Highway between Avenue I and Pacific Avenue in Redondo Beach	2.5	$75,000
SSR 27	Widen Topanga Canyon Boulevard to four lanes divided between Roscoe Boulevard and Devonshire Street near Chatsworth. (Los Angeles County Flood Control District's share, $39,000)	2.7	900,000 (State's share)
SSR 7 (Interstate 405)	Landscape San Diego Freeway between Mulholland Drive and 0.2 mile north of Ventura Boulevard	1.6	200,000
SSR 7	Surface and correct drainage on Sepulveda Boulevard between Burbank Boulevard near Van Nuys and 0.9 mile north of Rinaldi Street near San Fernando prior to relinquishment to City of Los Angeles	8.2	160,000
SSR 134	Landscape Ventura Freeway between Hollywood Freeway and Buena Vista Street in Burbank	3.0	175,000
US 66	Install and modify traffic signals at 33 intersections on Colorado Boulevard between Vernon and Sunnyslope Avenues in Pasadena. (City's share, $117,000)		125,000 (State's share)
SSR 15	6-lane Long Beach Freeway between San Bernardino Freeway at north city limit of Monterey Park and Valley Boulevard in Los Angeles; construct embankment and drainage facilities between Woods and Findlay Avenues in Monterey Park for future Pomona Freeway	2.0	3,400,000
SSR 35 (Interstate 605)	Construct overcrossings for future San Gabriel River Freeway at Centralia Road and 195th Street in and near Dairy Valley		650,000
SSR 35 (Interstate 605)	8-lane San Gabriel River Freeway between 166th Street in Dairy Valley and Cecilia Street at Norwalk-Downey city limit	3.6	10,250,000
SSR 35 (Interstate 605)	8-lane San Gabriel River Freeway between Cecilia Street at Norwalk-Downey city limit and 0.4 mile north of Telegraph Road in Santa Fe Springs, including interchange with Santa Ana Freeway	1.8	7,300,000
SSR 35 (Interstate 605)	8-lane San Gabriel River Freeway between 0.4 mile north of Telegraph Road in Santa Fe Springs and 0.8 mile north of Whittier Boulevard, northwest of Whittier	3.2	7,200,000
SSR 35	Widen Pioneer Boulevard-San Antonio Drive-Norwalk Boulevard and install and modify traffic signals between 166th Street and Lakeland Road in Norwalk. (City's share, $364,262)	3.8	290,000 (State's share)
SHR 172	8-lane Pomona Freeway between Santa Ana Freeway and Third Street in East Los Angeles, and construct embankment and drainage facilities and adjust sewers and streets between Findlay Avenue and Markland Drive in Monterey Park and Montebello	3.4	8,400,000
SHR 172	Resurface Third Street between Indiana and Fetterly Streets in East Los Angeles	1.8	75,000
SHR 172	Widen Potrero Grande Drive between Pomona Boulevard in Monterey Park and Hill Drive in South San Gabriel	1.7	150,000
SSR 26 (Interstate 10)	8-lane Santa Monica Freeway between US 101 Alternate in Santa Monica and San Diego Freeway in Los Angeles	3.7	7,500,000
SSR 14	Construct channelization and modify traffic signals at nine intersections on Artesia Boulevard between Pier Avenue in Manhattan Beach and Hawthorne Boulevard in Lawndale. (Manhattan Beach's share, $3,000; Redondo Beach, $68,000; Lawndale, $5,000)		125,000 (State's share)
SSR 14	Modify traffic signals at seven intersections on Artesia Boulevard between Normandie Avenue in Gardena and Wilmington Avenue. (Gardena's share, $11,250; Los Angeles, $10,750; County, $33,250)	3.7	55,000 (State's share)
SSR 14	Widen Artesia Boulevard and relocate traffic signals between Gridley Road and 0.1 mile east of Pioneer Boulevard in Artesia. (City's share, $35,300)	0.6	85,000 (State's share)
US 101, 60, 70, 99 (Interstate 405, 10)	Install reflectorized guide markers on San Diego Freeway between San Diego county line and Santa Ana Freeway; on Santa Ana Freeway between San Diego and Hollywood Freeways, and on San Bernardino Freeway between Long Beach and Santa Ana Freeways in Los Angeles and Orange Counties		55,000
SSR 35 (Interstate 605)	8-lane San Gabriel River Freeway between San Diego Freeway and 0.3 mile north of Katella Avenue near Los Angeles county line	2.4	5,500,000
Various	Rights-of-way (including $11,500,000 on Foothill Freeway; $9,000,000 on SSR 134 Freeway in Glendale and Eagle Rock; $7,900,000 on Artesia (Route 175) Freeway; $4,300,000 on San Gabriel River Freeway; $3,500,000 on Glendale Freeway; and $2,350,000 on Pomona Freeway)		56,975,000
	MADERA COUNTY		
SSR 145	Raise grade on portions between 0.4 mile and 4 miles north of the Fresno-Madera county line	3.6	60,000
Various	Rights-of-way		341,000
	MARIN COUNTY		
US 101	Additional lane, resurface, and additional signs on portions of US 101 between Golden Gate Bridge and foot of Waldo Grade	3.5	300,000
US 101	Reconstruct shoulders and install underdrains on portions between Atherton Avenue north of Novato and Marin-Sonoma county line		140,000
US 101	Median barrier between north end of San Rafael Viaduct and 0.2 mile north of Willow Avenue in San Rafael	1.9	120,000
US 101	Landscape between 0.6 mile south and 0.4 mile north of Freitas Parkway in San Rafael	1.0	100,000
Various	Rights-of-way		265,000
	MARIPOSA COUNTY		
Various	Rights-of-way		70,000
	MENDOCINO COUNTY		
US 101	Structures for future 4-lane freeway between Robinson Creek and 0.2 mile north of State Street, north of Ukiah	3.8	2,200,000
US 101	Widen to four lanes between 0.3 mile south of Willits and California Western crossing in Willits (City's share, $37,000)	1.4	410,000 (State's share)
US 101	Widen and truck passing lane between 1.0 and 3.5 miles north of Laytonville	2.3	500,000
SSR 1	2-lane expressway between 1.3 miles south of Big River and Russian Gulch, north of Mendocino	2.8	775,000
SSR 1	Replace bridge across DeHaven Creek north of Westport on new alignment and construct approaches	1.1	350,000
SSR 1	Replace bridge across Millbank Creek west of Leggett with culvert	0.2	35,000
Various	Rights-of-way		525,000
	MERCED COUNTY		
SSR 140	Widen and improve drainage near Kibby Road east of Merced	0.2	50,000
SSR 152	4-lane expressway between 1 mile west of Merced county line in Santa Clara County and 1.8 miles west of State Sign Route 33. (Relocation around San Luis Reservoir which will inundate the existing highway.) The Department of Water Resources has reserved $11,500,000 toward the project	12.4	5,000,000 (State Highway Fund share)
SSR 152 (Interstate 5)	Construct a bridge on SSR 152 over the future San Luis Canal 10 miles west of Los Banos; a bridge across the canal for the future Westside Freeway (Interstate 5), a mile northwest of the SSR 152 bridge; and portions of an interchange between SSR 152 and the Westside Freeway. (To be included in US Bureau of Reclamation's 18 mile canal project)	1.6	960,000 (State's share)
SSR 152	Widen to 4 lanes between Ortigalita Road and Nevada Street and between Mercy Springs Road and Nickel Street in Los Banos	1.5	400,000
Various	Rights-of-way		355,000
	MODOC COUNTY		
US 299	2-lane expressway between 4.5 and 8 miles east of Adin	3.3	665,000
Various	Rights-of-way		50,000

Route	Description	Approx. mileage	Estimated cost
	MONO COUNTY		
SSR 120 Tioga Pass Road	2-lane expressway between 8.6 and 10.6 miles west of Lee Vining	2.0	$1,285,000
Various	Rights-of-way		200,000
	MONTEREY COUNTY		
US 101	4-lane freeway between the San Luis Obispo-Monterey county line and 1.6 miles north of Gate One of Camp Roberts	2.4	1,270,000
US 101	4-lane freeway between 0.2 mile south of North Main Street in Salinas and 0.5 mile north of Espinosa Road	4.5	2,850,000
SSR 1	Replace bridge across Vicente Creek near Lucia and construct approaches	0.4	445,000
SSR 1	Grade for future 4-lane freeway between 1.2 miles south of Pajaro River and Santa Cruz-Monterey county line	1.2	600,000
SHR 118	Widen Salinas-Castroville Highway to 4-lane city street and resurface between Main Street in Salinas and 0.1 mile west of the west city limit	1.2	220,000
Various	Rights-of-way		1,325,000
	NAPA COUNTY		
SSR 29	4-lane freeway between Old Sonoma Road in Napa and Napa Creek, and resurface existing 2 lanes between Napa Creek and 0.2 mile south of Trancas Street in Napa	2.2	980,000
Various	Rights-of-way		775,000
	NEVADA COUNTY		
SSR 49	Widen portions between 1.5 miles north of South Fork of Yuba River and North San Juan		50,000
US 40 (Interstate 80)	Pave 4-lane freeway between Soda Springs and 1 mile west of junction with State Sign Route 89 west of Truckee. (Completes Donner Summit relocation)	10.6	5,455,000
SSR 89	Resurface and improve drainage between Donner Creek Underpass southwest of Truckee and 3.6 miles south	3.6	190,000
Various	Rights-of-way		510,000
	ORANGE COUNTY		
US 101 (Interstate 5)	Widen Santa Ana Freeway to 6 lanes and install median barrier between State Highway Route 185 (Laguna Canyon Road) and Browning Avenue, about 5 miles north of Irvine	5.5	1,290,000
US 101 (Interstate 5)	Widen Santa Ana Freeway to 6 lanes between Browning Avenue, 5 miles north of Irvine, and 0.1 mile south of Santiago Creek, and construct ramps and frontage road at Newport Boulevard in Tustin	4.8	1,550,000
SSR 55, US 101	Tree planting on Newport Freeway between 0.5 mile south of Santa Ana Freeway and 0.7 mile northeast of US 91, and on Santa Ana Freeway between 0.5 mile southeast and 0.5 mile northwest of Newport Freeway		35,000
US 101 Alt.	Widen Pacific Coast Highway to 4 lanes divided and modify traffic signals between 0.2 mile north of Vista Del Sol in South Laguna and south city limit of Laguna Beach	2.2	205,000
Interstate 405	8-lane San Diego Freeway between Newland Street and 0.6 mile east of Bolsa Chica Road in Westminster and Huntington Beach	4.3	8,900,000
SSR 35 (Interstate 605)	8-lane San Gabriel River Freeway between San Diego Freeway and 0.3 mile north of Katella Avenue near Los Angeles county line	2.4	5,500,000
SSR 14	Interchange at Dowling Avenue in Anaheim to convert Riverside Freeway to full freeway		930,000
SHR 176	Widen at intersections and install traffic signals and highway lighting on Imperial Highway between 0.2 mile west of Puente Avenue in Fullerton and 0.2 mile east of Arovista Avenue in Brea. (Fullerton's share, $7,500; Brea's share, $6,000	9.6	35,000 (State's share)
SSR 22	6-lane Garden Grove Freeway between Garden Grove Boulevard near Hester Street in Garden Grove and Placentia Avenue in Orange	1.1	1,400,000
	RIVERSIDE COUNTY		
US 60	4-lane freeway extension between Kitching Street east of Sunnymead and State Sign Route 79 northeast of Moreno	6.8	2,705,000
US 60, 70, 99 (Interstate 10) SSR 111	Install signs and highway lighting at the intersections of US 60-70-99 and SSR 111 west of Whitewater, and intersection of US 60-70-99 and Indian Avenue in Garnet		90,000
US 395	Landscape onramp between "G" and "D" Streets in Perris	0.5	15,000
US 395, SSR 74	Planting, including trees, between Watson Road, north of Romoland, and "G" Street in Perris		10,000
SSR 111	Widen from 2 to 4 lanes between Cathedral City and State Sign Route 74 at Palm Desert	6.6	1,000,000
SSR 111	Widen to 4 lanes between Indian Trail in Palm Springs and Cathedral City	4.7	525,000
SHR 187	4-lane expressway through Dry Morongo Canyon 70.0 miles northeast of Whitewater	4.1	1,900,000
SHR 193	Widen Hamner Avenue to 4 lanes between US 91 in Corona and 0.3 mile south of Santa Ana River near Norco	4.2	300,000
US 70-99 (Interstate 10)	Convert 4-lane expressway to 6-lane freeway between Beaumont and Redlands	11.7	7,200,000
US 60-70 (Interstate 10)	4-lane freeway between 3.5 miles east of US 99 east of Indio and 9.7 miles west of Cottonwood Springs Road near the intersection with State Sign Route 195	10.0	3,500,000
SSR 111	Widen to 4 lanes between Deep Canyon Road in Palm Desert and 1.3 miles westerly	1.3	250,000
Various	Rights-of-way		3,035,000
	SACRAMENTO COUNTY		
US 50-99	Landscaping and planting, including trees, on South Sacramento Freeway between Sacramento Boulevard and Stevenson Avenue	4.9	315,000
US 40 (Interstate 80)	Superstructure and freeway approaches for Sacramento River Bridge between Sacramento Northern Railroad in Yolo County and Fifth Street in Sacramento. (Substructure finance in the 1962-63 budget	1.2	11,000,000
Various	Rights-of-way (including $6,450,000 for US 40 Freeway between West Sacramento and 34th Street in Sacramento)		10,000,000
	SAN BENITO COUNTY		
SSR 156	Tree planting on portions between 0.3 mile west of west city limit of San Juan Bautista and 0.3 mile west of San Benito River		3,000
Various	Rights-of-way		115,000
	SAN BERNARDINO COUNTY		
SHR 187	4-lane expressway through Dry Morongo Canyon 7.0 miles northeast of Whitewater	4.1	1,900,000
US 66	Channelization between Etiwanda Avenue west of Fontana and Macy Street in San Bernardino	10.4	60,000
US 70-99 (Interstate 10)	Planting, including trees, between US 91-395 in Colton and Colton Avenue in Redlands		30,000
US 70-99 (Interstate 10)	Convert 4-lane expressway to 6-lane freeway between Beaumont and Redlands	11.7	7,200,000
US 70-99 (Interstate 10) US 91-395 (Interstate 15)	New connection between US 91-395 (Interstate 15, westbound to San Bernardino Freeway (US 70-99, Interstate 10) in Colton in San Bernardino	1.4	580,000

Route	Description	Approx. mileage	Estimated cost
	SAN BERNARDINO COUNTY—Continued		
US 66-91-395 (Interstate 15)	Planting, including trees, between 27th Street in San Bernardino and 1.4 miles north of Devore		$35,000
US 395-66-91 (Interstate 15)	Widen San Bernardino Freeway to 6 lanes between Riverside Freeway in Colton and Third Street in San Bernardino, and widen shoulders from Third Street to Base Line Street	3.9	350,000
SSR 18	Convert 2-lane highway and expressway to 4-lane expressway between 44th Street in City of San Bernardino and 1 mile north of city limit	1.8	275,000
SSR 18 SHR 188	Interchange between State Highway Route 188 and SSR 18 near Crestline	1.0	1,000,000
US 66 (Interstate 40)	4-lane freeway between 1.0 mile east of US 91 in Brastow and 2.5 miles east of Daggett	9.0	5,200,000
US 66-95	Widen shoulders and resurface between Needles and 26 miles west	26.3	250,000
US 66-95 (Interstate 40)	Construct underpass and approaches at the Atchison, Topeka and Santa Fe Railway tracks in Needles	1.4	1,450,000
SHR 207	Widen City Creek Highway to 4 lanes between 1.5 and 2.5 miles southwest of Running Springs	1.0	285,000
Various	Rights-of-way (including $1,300,000 on US 66 (Interstate 40) between Barstow and Colorado River)		3,980,000
	SAN DIEGO COUNTY		
US 101 (Interstate 5)	8-lane freeway between Eighth Street in National City and south city limit	1.6	2,400,000
US 101 (Interstate 5)	Landscaping between Sixth Avenue and Palm Street in San Diego	1.2	180,000
US 101 (Interstate 5)	6-lane freeway between Maple and Washington Streets in San Diego	1.6	3,300,000
US 101 (Interstate 5)	8-lane freeway between Via de la Valle near Del Mar and San Marcos Road north of Encinitas	5.1	4,900,000
US 101 (Interstate 5)	Revise signing between Leucadia and Camp Pendleton Road	13.0	55,000
US 101 (Interstate 5)	Widen existing highway to 4 lanes divided between Border Avenue north of Del Mar Race Track and 0.2 mile north of Cardiff Beach State Park	2.0	160,000
US 80 (Interstate 8)	Tree planting from Taylor Street in San Diego to west city limit of El Cajon and landscaping from west city limit to East Main Street in El Cajon		240,000
US 80 (Interstate 8)	4-lane freeway from East Main Street in El Cajon easterly to Harritt Road	4.0	3,300,000
US 395	Convert 2-lane expressway to 4-lane freeway between two miles north of Miramar Road and 0.8 mile north of Poway Road in San Diego	2.7	3,100,000
US 395	Widen to 4-lane expressway between 1.3 miles north of Lake Hodges Bridge and 0.3 mile north of 17th Avenue in Escondido	2.0	400,000
SSR 78	Tree planting between 1 mile west of Vista and Nordahl Road near Escondido		30,000
SSR 78	4-lane freeway between 2.7 miles east of San Marcos and US 395 in Escondido	1.8	2,100,000
SSR 67	Structures at Prospect Avenue and Woodside Avenue in and near Santee for future 4-lane freeway	1.1	250,000
SSR 94	Widen between Campo and 0.6 mile west	0.6	170,000
Various	Rights-of-way (including $4,800,000 on US 101 in and north of San Diego; $3,000,000 on Route 241 (Inland) Freeway in San Diego area; and $1,900,000 on SSR 94 east of La Mesa)		13,254,500
	SAN FRANCISCO COUNTY		
SHR 239 (Interstate 280) US 101, SSR 1	8- and 10-lane Junipero Serra Freeway between 0.4 mile south of Eastmoor Avenue in Daly City and just south of Alemany Boulevard in San Francisco; 6-lane Southern Freeway between Junipero Serra Freeway and 0.3 mile east of Orizaba Avenue in San Francisco; grade and construct frontage road and drainage structures for future freeway on SSR 1 between St. Francis Boulevard in Daly City and Junipero Serra Freeway	3.9	10,100,000
US 101	Landscape Southern Freeway between near Mission Street and James Lick Memorial Freeway Interchange	1.1	110,000
SHR 224 (Interstate 480)	Construct ramp connections between Embarcadero Freeway and Clay and Washington Streets	0.4	1,350,000
Various	Rights-of-way (including $2,300,000 for Southern Freeway-Embarcadero Freeway Extension)		2,600,000
	SAN JOAQUIN COUNTY		
US 50	Resurface between Kasson Road northeast of junction with SSR 33 and San Joaquin River	3.3	70,000
SSR 120	Widen shoulders between US 50 and 0.3 mile east of west city limit of Manteca	3.9	100,000
SSR 120	Widen to 40-foot city street section for 1.2 miles through Escalon and construct channelization. (City's share, $12,000)	1.2	75,000 (State's shar
Various	Rights-of-way		2,150,000
	SAN LUIS OBISPO COUNTY		
US 101	4-lane freeway between 0.9 mile north of San Miguel and Monterey county line	2.3	1,330,000
US 101	Reconstruct and resurface portions of 4-lane expressway between Atascadero and Paso Robles	9.0	385,000
SSR 1	4-lane freeway between Old Creek south of Cayucos and 1.2 miles north of Cayucos Creek	2.8	3,050,000
SHR 125	Reconstruct between Salinas River Bridge near Atascadero and 0.1 mile west of Huer Huero Creek	9.7	140,000
US 101	Tree planting between 4 miles south of Santa Maria and Hourihan Grade in San Luis Obispo County		20,000
Various	Rights-of-way		930,000
	SAN MATEO COUNTY		
SSR 1	Construct Gateway Drive undercrossing and approaches in Daly City		270,000
US 101 (Bypass)	Level and resurface portions of Bayshore Freeway between Whipple Avenue Overcrossing in Redwood City and Fifth Avenue in San Mateo		850,000
SHR 105	Landscape 19th Avenue Freeway between 0.6 mile north of West Hillsdale Boulevard Extension and South Delaware Street in San Mateo	1.8	225,000
SHR 214	4-lane expressway between Cypress Street in Redwood City and Bayshore Freeway and an interchange at Five Points with El Camino Real (US 101). (City's share, $1,000,000)	1.3	1,250,000 (State's shar
SHR 239 (Interstate 280)	Junipero Serra Freeway bridge over Stanford Linear Accelerator 1.2 miles southeast of Woodside		500,00
SHR 239 (Interstate 280), US 101, SSR 1	8- and 10-lane Junipero Serra Freeway between 0.4 mile south of Eastmoor Avenue in Daly City and just south of Alemany Boulevard in San Francisco; 6-lane Southern Freeway between Junipero Serra Freeway and 0.3 mile east of Orizaba Avenue in San Francisco; grade and construct frontage road and drainage structures for future freeway on SSR 1 between St. Francis Boulevard in Daly City and Junipero Serra Freeway	3.9	10,100,00
Various	Rights-of-way (including $8,700,000 for Junipero Serra Freeway)		10,605,00

Route	Description	Approx. mileage	Estimated cost
	SANTA BARBARA COUNTY		
US 101	Planting, including trees, between El Sueno Road north of Santa Barbara and Elwood	8.0	$150.000
US 101	4-lane freeway bypass of Buellton between 0.7 mile south of Santa Ynez River and 0.7 mile north of Buellton	1.8	3.250.000
US 101	Tree planting between 4.0 miles south of Santa Maria and Hourihan Grade in San Luis Obispo County		20.000
SSR 150	Reconstruct and realign highway between 1.4 and 2.8 miles west of Buellton	1.4	150.000
Various	Rights-of-way		1.930.000
	SANTA CLARA COUNTY		
US 101	Resurface between Llagas Creek Bridge and El Toro Avenue in Morgan Hill	3.6	200.000
SSR 17	Widen, resurface and channelize at Summit Road SSR 5 Intersection at Santa Clara-Santa Cruz county line	0.3	55.000
SSR 152	Widen shoulders and resurface between 2.9 miles west and 2.9 miles east of Bells Station east of Gilroy	5.9	350.000
US 101	Planting, including trees, between Agnew Road in Sunnyvale and 2 miles southerly	2.0	100.000
SSR 114	4-lane Stevens Creek Freeway between 0.1 mile south of Homestead Road in Cupertino and US 101 Bypass Bayshore Freeway in Mountain View. Santa Clara County's share, $40.000	5.5	6.560.000 State's share
SHR 239 Interstate 280	6-lane Junipero Serra Freeway between 0.6 mile east of Saratoga Avenue in San Jose and Saratoga-Sunnyvale Road (SSR 9) in Cupertino, and grading for future freeway construction between Saratoga-Sunnyvale Road and Stelling Road in Cupertino. Santa Clara County Flood Control and Water Conservation District's share, $135.000	4.6	4.455.000 State's share
FAS 992 Urban Extension	Widen Leavesley Road from 2 to divided 4 lanes between Monterey Road and the east city limit of Gilroy, and install traffic signals and automatic warning signals at railroad crossing. Urban extension of federal aid secondary county road. Gilroy's share, $100.000	0.5	100.000 State's share
FAS 995 Urban Extension	Widen Saratoga Avenue to divided 4-lanes between Stevens Creek Road and Scott Boulevard-Newhall Street in Santa Clara, and construct bridge across San Tomas Creek. Urban extension of FAS county road. City of Santa Clara's share, $176.300; Santa Clara County's share, $54.700	1.3	231.000 State's share
FAS 1015 Urban Extension	Two lanes of ultimate divided 4-lane Capitol Expressway between Senter and Tuers Roads in San Jose, and construct bridge across Coyote Creek. Urban extension of FAS county road. San Jose's share, $90.500; Santa Clara County's share, $90.500	0.5	181.000 State's share)
SSR 152	4-lane expressway between 1 mile west of Merced county line in Santa Clara County and 1.8 miles west of State Sign Route 33. Relocation around San Luis Reservoir which will inundate the existing highway. The Department of Water Resources has reserved $11.500.000 toward this project	12.4	5.000.000 State's share
Various	Rights-of-way including $2.800.000 for Junipero Serra Freeway		5.140.000
	SANTA CRUZ COUNTY		
SSR 1, SHR 67	Grade and structures for future freeway on portions of SSR 1 between Monterey county line and 1.5 miles northwest of Buena Vista Drive near Watsonville; grade portion for 4-lane highway on SHR 67 between SSR 1 and east of Main Street in Watsonville	3.8	2.100.000
SSR 17	Widen, resurface and channelize at Summit Road SSR 5 Intersection at Santa Clara-Santa Cruz county line	0.3	55.000
Various	Rights-of-way		120.000
	SHASTA COUNTY		
US 99 Interstate 5 SSR 44	Grade and structures for future 4-lane Redding Freeway on US 99 between Riverside Avenue north of Anderson and 2 miles north of Redding; 4-lane freeway on SSR 44 between Market Street in Redding and Hilltop Road east of the city	14.1	7.700.000
SSR 44	2-lane expressway between Airport Road and Cow Creek east of Redding	4.5	950.000
Various	Rights-of-way		850.000
	SIERRA COUNTY		
SSR 49	Replace bridge across North Yuba River on new alignment and construct approaches	0.4	365.000
SSR 49	Widen portions between Bassetts and Yuba Pass		100.000
Various	Rights-of-way		10.000
	SISKIYOU COUNTY		
US 99 Interstate 5	4-lane Mount Shasta Freeway between 4.6 miles south and 1.5 miles north of city	6.8	4.800.000
Various	Rights-of-way		100.000
	SOLANO COUNTY		
US 40 Interstate 80	Truck shelter and tool house at Cordelia Scale and Brake Inspection Station		155.000
US 40 Interstate 80	Convert 4-lane expressway to 6-lane freeway between 0.2 mile north of Travis Boulevard and 1.0 mile southwest of Vacaville	7.0	5.300.000
SSR 12	Replace Happe Drain Bridge 1.6 miles northwest of Rio Vista and construct approaches	0.3	80.000
Interstate 680	Planting, including trees, between Laurel Street near Vallejo and Benicia-Martinez Bridge	7.0	150.000
SSR 48	Reconstruct approach spans of Sonoma Creek Bridge		775.000
Various	Rights-of-way		420.000
	SONOMA COUNTY		
US 101	4-lane freeway between 1.7 miles north of Canyon Road south of Cloverdale and 0.8 mile south of Washington School Road Zanzi's Corner	1.6	1.200.000
SSR 1	Install underdrains on portions between Bodega Bay and SSR 12 at Jenner		65.000
SSR 12	Replace timber-steel retaining wall with concrete viaduct 1.6 miles west of Guerneville	0.3	200.000
SSR 48	Reconstruct approach spans of Sonoma Creek Bridge		775.000
Various	Rights-of-way		525.000
	STANISLAUS COUNTY		
US 99	Pave 6-lane freeway between Ceres and 2.4 miles north of Modesto	7.0	4.150.000
Various	Rights-of-way		1.150.000
	SUTTER COUNTY		
US 99E	Widen to 4 lanes between Queens Avenue at north city limit of Yuba City and 0.8 mile north, and widen additional 0.8 mile section of existing 2-lane highway to 0.3 mile north of Pease Road	1.6	335.000
SHR 245	Widen Garden Highway and Tudor Road between 0.2 mile north of Sacramento Avenue 1.6 miles northwest of Nicolaus and US 40 Alternate	7.2	200.000
Various	Rights-of-way		100.000

Route	Description	Approx. mileage	Estimated cost
	TEHAMA COUNTY		
US 99E	Channelize and improve intersections on portions between SSR 36 east of Red Bluff and Samson Slough	1.8	$140,000
US 99W (Interstate 5)	Structures and approaches for future Red Bluff Freeway between existing US 99W immediately south of Red Bluff and 0.2 mile north of Adobe Road	3.0	3,160,000
Various	Rights-of-way		300,000
	TRINITY COUNTY		
US 299	2-lane expressway between 5.6 and 8 miles east of Douglas City	2.1	1,695,000
	TULARE COUNTY		
US 99	Planting, including trees, on portions between 1 mile south of Sherwood Avenue in McFarland and Kings River in Tulare County		125,000
SSR 198	4-lane freeway between 0.3 mile west of Woodland Drive west of Visalia and Second Avenue east of Visalia; grade and structures for future 4-lane freeway and expressway between Second Avenue and 0.3 mile east of SSR 65 North	11.9	4,390,000
SHR 131	Replace Kings River Bridge on Road 400 and construct approaches and remove overflow bridge east of Kingsburg	0.9	290,000
SSR 63	Grade and pave 1-way couplet on Court-Northwest Third and Locust-Northwest Second Streets between SSR 198 in Visalia and 0.1 mile north of Houston Avenue	1.2	115,000
Various	Rights-of-way		576,000
	TUOLUMNE COUNTY		
Various	Rights-of-way		350,000
	VENTURA COUNTY		
US 101	Convert Ventura Freeway to full freeway between 0.5 mile west of Triunfo Road east of Thousand Oaks and 0.5 mile east of Moorpark Road	2.6	675,000
US 101	Convert Ventura Freeway to full freeway between 0.5 mile west of Moorpark Road and 0.4 mile west of Borchard Road	2.1	750,000
US 101	Interchange between Ventura Freeway and Old Conejo Road	0.6	470,000
US 101, US 399	Landscape Ventura Freeway between California Street in Ventura and Ventura River, and Ojai Freeway between Ventura Freeway and Prospect Street just north of city	1.4	250,000
US 101	Resurface portions between 0.2 mile north of Ventura and 1 mile north of Seacliff		135,000
SSR 118	Widen intersections between Los Angeles Avenue-Moorpark Road (SSR 23) at Moorpark and Los Angeles county line		100,000
SSR 126	4-lane freeway between 0.1 mile west of Wells Road and 0.7 mile east of Santa Paula	8.5	7,200,000
US 399	Tree planting on Ojai Freeway between Prospect Street and 0.3 mile south of Mills School just north of Ventura		3,000
FAS 1164 (Urban Extension)	Two lanes of ultimate divided 4-lane roadway on Harbor Boulevard between Channel Drive and East Main Street (US 101) in Ventura, and constructing overhead across Southern Pacific Railroad tracks and installing traffic signals. (Urban extension of FAS county road. City of Ventura's share, $112,500)	0.7	112,500 (State's share
Various	Rights-of-way		2,955,000
	YOLO COUNTY		
US 40 (Interstate 80)	Superstructure and freeway approaches for Sacramento River Bridge between Sacramento Northern Railroad in Yolo County and Fifth Street in Sacramento. (Substructure financed in the 1962 63 budget)	1.2	11,000,000
Various	Rights-of-way		50,000
	YUBA COUNTY		
SSR 20	Widen to 4 lanes between US 40 Alternate and Yuba Street in Marysville and construct underpass at the Southern Pacific Railroad tracks	0.2	585,000
Various	Rights-of-way		130,000

printed in CALIFORNIA STATE PRINTING OFFICE 75040 12-62 65 500

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

HIGHWAY TRANSPORTATION AGENCY

ROBERT B. BRADFORD . . . Administrator

DEPARTMENT OF PUBLIC WORKS . . . ROBERT B. BRADFORD, Director

RUSSELL J. COONEY . . Deputy Director (Management)
HARRY D. FREEMAN . . Deputy Director (Planning)

FRANK A. CHAMBERS . . . . Chief Deputy Director
T. F. BAGSHAW . . . . . Assistant Director
JOHN H. STANFORD . . . . . Assistant Director

JUSTIN DuCRAY . Departmental Management Analyst
S. ALAN WHITE . . Departmental Personnel Officer

DIVISION OF HIGHWAYS

J. C. WOMACK . . . State Highway Engineer, Chief of Division

CHAS. E. WAITE . . . Deputy State Highway Engineer
J. P. MURPHY . . . Deputy State Highway Engineer
J. A. LEGARRA . . Deputy State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
GEO. LANGSNER . . Assistant State Highway Engineer
FRANK E. BAXTER . Assistant State Highway Engineer
J. C. BURRILL . . . . . Comptroller
C. G. BEER . . . . . Urban Planner
L. L. FUNK . . . . . Planning Engineer
F. N. HVEEM . . . Materials and Research Engineer
J. F. JORGENSEN . . . . . Construction Engineer
SCOTT H. LATHROP . Personnel and Public Information
C. T. LEDDEN . . City and County Projects Engineer
H. C. McCARTY . . . . . Office Engineer
E. J. L. PETERSON . . Program and Budget Engineer
R. V. POTTER . . . . Systems Research Engineer
F. M. REYNOLDS . . . . Planning Survey Engineer
EARL E. SORENSON . . . . . Equipment Engineer
E. L. TINNEY . . . . . Maintenance Engineer
W. L. WARREN . . . . . Engineer of Design
G. M. WEBB . . . . . Traffic Engineer
. L. ELLIOTT . . . . Bridge Engineer—Planning
. C. HOLLISTER . Bridge Engineer—Special Projects
. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area

Right-of-Way

RUDOLF HESS . . . . . Chief Right-of-Way Agent
DEXTER D. MacBRIDE . . . . . Assistant Chief
RAY E. O'BIER . . . . . Assistant Chief
R. S. J. PIANEZZI . . . . . Assistant Chief
JACQUES T. ZEEMAN . . . . . Assistant Chief

District I, Eureka

SAM HELWER . . . . . District Engineer

District II, Redding

H. S. MILES . . . . . District Engineer

District III, Marysville

ALAN S. HART . . Assistant State Highway Engineer

District IV, San Francisco

J. P. SINCLAIR . . Assistant State Highway Engineer
L. A. WEYMOUTH . . . . . District Engineer
R. A. HAYLER . . . . . District Engineer
HAIG AYANIAN . . . . . District Engineer

District V, San Luis Obispo

E. R. FOLEY . . . . . District Engineer

District VI, Fresno

W. L. WELCH . . . . . District Engineer

District VII, Los Angeles

E. T. TELFORD . . . Metropolitan District Engineer
A. L. HIMELHOCH . . . . . District Engineer
GEORGE A. HILL . . . . . District Engineer
A. C. BIRNIE . . . . . District Engineer
A. W. HOY . . . . . District Engineer

District VIII, San Bernardino

C. V. KANE . . . . . District Engineer

District IX, Bishop

C. A. SHERVINGTON . . . . . District Engineer

District X, Stockton

JOHN G. MEYER . . . . . District Engineer

District XI, San Diego

JACOB DEKEMA . . Assistant State Highway Engineer

State-owned Toll Bridges

CHARLES L. SWEET . . . . . Bridge Engineer

CALIFORNIA HIGHWAY COMMISSION

ROBERT B. BRADFORD . Chairman and Director of Public Works
ARTHUR T. LUDDY . . Vice Chairman, Sacramento
JAMES A. GUTHRIE . . San Bernardino
ROGER S. WOOLLEY . . . San Diego
JOHN ERRECA . . . . . Los Banos
ABRAHAM KOFMAN . . . San Jose
FRANKLIN S. PAYNE . . Los Angeles
JACK COOPER, Secretary . . . Sacramento

DIVISION OF CONTRACTS AND RIGHTS-OF-WAY (LEGAL)

ROBERT E. REED . . . . . Chief Counsel

EORGE C. HADLEY . . . . . Assistant Chief
HOLLOWAY JONES . . . . . Assistant Chief
HARRY S. FENTON . . . . . Assistant Chief

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

NORMAN C. RAAB . . . . Chief of Division
BEN BALALA . . . . . Principal Bridge Engineer

DIVISION OF ARCHITECTURE

EARL W. HAMPTON . . . Acting State Architect, Chief of Division

RL W. HAMPTON . . . . . Deputy Chief, Architecture and Engineering
BERT S. HUNTER . . . . . Deputy Chief, Administrative
CHARLES M. HERD . . . . . Chief Construction Engineer

ARTHUR F. DUDMAN . . . . . Assistant State Architect (North)
TOM MERET . . . . . Assistant State Architect (South)

DIVISION OF AERONAUTICS

CLYDE P. BARNETT . . . . . Director, Chief of Division

California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

RETURN REQUESTED

SEATTLE PUBLIC LIBRARY
4TH & MADISON
SEATTLE 4, WASHINGTON

R56

BULK RATE
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152





CALIFORNIA Highways and Public Works

TECHNOLOGY
FILE IN STACKS

APR 18 1963

JANUARY-FEBRUARY
1963

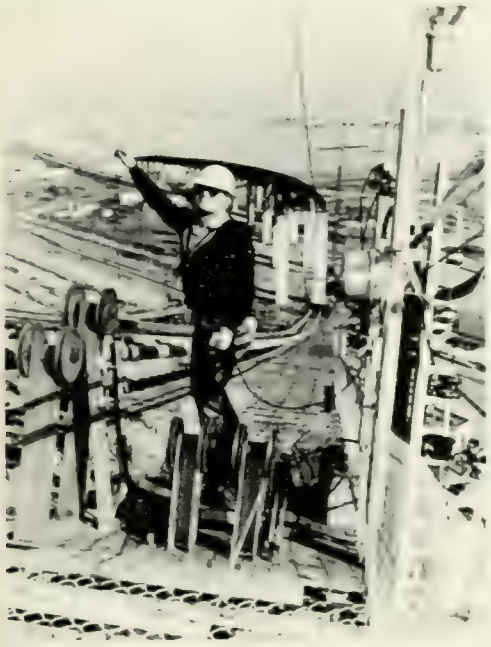


When January 1963 went out like a lion with a roaring three-day month's-end storm, as much as 16 inches of rain fell on some sections of the Sierra Nevada. With virtually no snowpack to absorb the water, and the ground hard frozen, the runoff was like that from a tin roof. By the second day of the storm, normally mild mountain streams had changed into raging torrents, and every road across the Sierra south of Sign Route 36 was closed by slides and washouts. Photo above shows school children changing from one school bus to another at Spanish Creek bridge just north of Quincy on U.S. 40 Alternate, on February 8th, while the bridge was still under repair. (Photo by Robert Mulno.) *For more storm photos see pages 33, 34 and 35.*

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

Vol. 42 January-February 1963 Nos. 1-2



FRONT COVER: Division of Highways Photographer Robert Dunn climbed to the top of the tower to get this shot on the uncompleted Vincent Thomas Bridge connecting the City of San Pedro and Terminal Island in Los Angeles Harbor. Photo shows contractor's man at work on cable spinning, which was completed in early December 1962. (See story page 9 et seq.)

BACK COVER: At some risk to self and equipment, Division of Highways Photographer William Ruland took this time exposure night picture on U.S. 40 while skidproofing operations were going on. (See story page 44 et seq.)



CONTENTS

	Page
Sepulveda Pass	2
Santa Maria	4
By L. D. Kraatz and L. A. Paglia, Resident Engineers	
Grapevine Grade Accidents Reduced	8
Cable Spinning	9
By John B. Poppe, Assistant Resident Engineer	
Cliff Face Threat	14
Luddy, Wolley Reappointed to Highway Commission	17
Big Bear Road	18
By L. M. Barnett, District Construction Engineer, and J. L. Riddell and W. McKnight, Resident Engineers	
State's Relocation Policy Is Praised	21
Tehachapi Job	22
By Charles H. Jackson, Resident Engineer	
San Mateo-Hayward Bridge	25
By Norman C. Raab, Projects Engineer	
Sierra County Thanks Division for Fast Flood Damage Repair	32
Sierra Rains	33
U.S. 60 Freeway	36
By Taylor Smith, Resident Engineer	
Pixley-Tulare	40
By K. P. Oliphant, Assistant Highway Engineer	
Hill, Deffebach, Webb Named to New Posts	43
Skidproofing	44
By R. D. Kinsey, Assistant District Engineer	
Lady Engineers	46
By Louise Gohdes, Assistant Information Officer	
Fossil Find	50
Highway Exhibits	52
By Barry Cohon, Assistant Information Officer	
More Routes	54
Earl E. Sorenson Retires, John Beaton Is Named	57
Greene, Ayanian Reassigned in S.F.	59
1962 Index to California Highways and Public Works	61
Twenty-five-year List	43

Retirements

Department Retirements	58	Thomas Mendenhall	59
Rudy Bergroth	56	Frank and Frances Reynolds	60
E. F. Carter	57	Hazeldean Snedden	60
W. S. Cully	58	Earl E. Sorenson	57
G. L. Laird	59	L. A. Weymouth	58

Obituaries

In Memoriam	17	James B. Woodson	60
Harry Mathewson	45		

LESTER S. KORITZ, *Editor*

STEWART MITCHELL, *Associate Editor* JOHN C. ROBINSON, *Associate Editor*

WILLIAM R. CHANEY, *Chief Photographer*

Editors are invited to use information contained herein and to request prints of any black and white photographs.

Address communications to: EDITOR,

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

P. O. Box 1499

SACRAMENTO, CALIFORNIA

Sepulveda Pass

Completed $20 Million Contract Opens Major San Fernando-Western Los Angeles Route



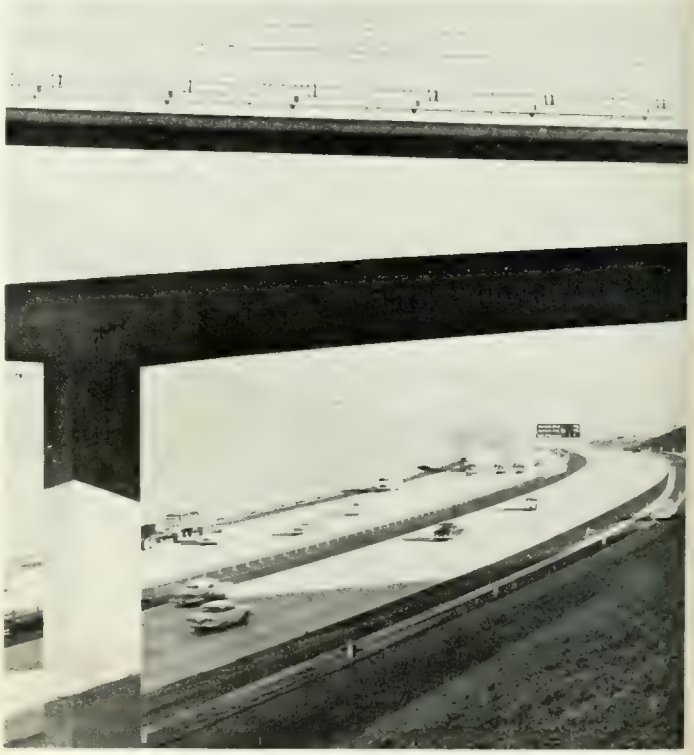
Caravan of cars starts over new section of San Diego Freeway through Mulholland Cut directly after ribbon cutting.



Traffic between West Los Angeles and the San Fernando Valley, which has been crossing the Santa Monica Mountains on four-lane Sepulveda Boulevard since 1935, was switched to a new eight-lane section of the San Diego Freeway after dedication ceremonies held December 21. A crowd estimated at 800 gathered for the ribbon cutting and later drove the 5.7-mile section in a 365-car caravan. Many who had traveled the old road regularly were quick to note the contrast between its sharp curves, steep grades and three-lane tunnel and the long sweeping curves and maxi-



Director of Public Works Bradford, representing Governor Brown who could not appear because of bad flying weather, says, "At long last we are beginning to narrow the gap between traffic and freeway miles. . . ."



View of new freeway section, looking northward, after ribbon cutting and under normal traffic use. San Fernando Valley and San Gabriel range in distance.

mum 5½-percent grade of the new freeway.

The project, a link of Interstate Route 405, is part of a $20,000,000 contract, largest ever awarded by the Division of Highways. Approximately 18,000,000 cubic yards of earth moved under this and earlier contracts were used in the construction of 38 miles of freeways in District VII.

Governor Detained by Fog

Federal, state and local officials participated with representatives of many civic organizations in the dedication ceremony. Members of the California Highway Commission, in Los Angeles for their regular monthly meeting, were joined by two former members, Harrison Baker of Pasadena and Robert E. McClure of Santa Monica. Robert B. Bradford, Director of Public Works, represented Governor Brown, who was unable to fly from Sacramento when fog stopped air traffic.

Bradford read a message from the Governor, pointing out the increased safety, speed and convenience to be enjoyed by the thousands of motorists who travel daily between the San Fernando Valley and West Los Angeles. "With the possible exception of the dedication of the downtown Los Angeles freeway loop last March, this is the most gratifying experience of this kind that I have had. At long last we are beginning to narrow the gap between traffic needs and freeway miles, and we are beginning to enjoy the fruits of good planning carried on under a highway program free from political interference," the statement said.

100,000 Vehicles Daily

Edward T. Telford, metropolitan district engineer, describing the project, said: "We are standing in one of the largest highway cuts in the world, 180 feet across and 260 feet deep. The superlatives attached to the planning and building of this freeway also can be assigned to the benefits to be derived. It will save time, money and nerves and be more than twice as safe as the old road. Forty thousand vehicles now use this pass daily. Within another six months, when we hope to complete the San Diego Freeway from the City of San Fernando to Long Beach, a distance of 40 miles, I believe 100,000 vehicles a day will travel through this canyon."



Mayor Sam Yorty of Los Angeles, who arrived on the scene in city fire department helicopter, delivers a dedication address to audience of officials and local citizens.

Los Angeles Mayor Samuel W. Yorty broke the ceremonial ribbon as he left the dedication scene in a fire department helicopter to lead the motor caravan over the new freeway.

Replaces Sepulveda Boulevard

The new eight-lane freeway section, extending from Casiano Road near Sunset Boulevard to Valley Vista Boulevard near the Ventura Freeway in the Valley, will carry through traffic which formerly used Sepulveda Boulevard, which has been rebuilt and realigned to serve local traffic needs.

The "big cut" has a maximum grade of 5½ percent, long sweeping curves, a 22-foot median strip with cable chain link barrier, 10-foot shoulders and an extra southbound uphill lane for truck traffic.

The contract was performed by the Guy F. Atkinson Company.



Some families chose to be spectators and view opening ceremonies from slopes of Mulholland Cut.

Santa Maria

U.S. 101 Freeway Skirts Rapidly Growing City

By L. D. KRAATZ, and L. A. PAGLIA, Resident Engineers



Recent completion of an 8½-mile freeway project bypassing the City of Santa Maria on U.S. 101 has eliminated a major bottleneck for through traffic on this important north-south coast route. With the exception of some portions of U.S. 101 in Santa Barbara and a minor deficiency in Buellton, a motorist can now travel from the south Santa Barbara county line to the north San Luis Obispo county line on four-lane divided highway for 170 miles without seeing a stop sign or a traffic signal.

This significant achievement was brought about, in part, by the rapidly changing complexion of the northern Santa Barbara County area.

The City of Santa Maria, located in the middle of a long, flat agricultural valley formed by the Santa Maria River, had for many years been a stable, peaceful small city depending on extensive agricultural and oil operations for its economic life. The city was fairly evenly divided by U.S. 101, which ran in a north-south direction through town. Commercial development both north and south of the main sections of town with its consequent heavy cross traffic slowed down through traffic and greatly increased local traffic congestion.

For this reason alone, the Division of Highways as early as 1953 conducted engineering studies of many alternate routes of U.S. 101 in this area so as to alleviate these major local traffic problems. An alignment bypassing the city on the east was finally selected because of considerably lower right-of-way acquisition and highway construction costs.

Traffic Congestion Magnified

The existing problem of traffic congestion was intensively magnified by the activation of Vandenberg Air Force Base, close to nearby Lompoc, as a missile-testing and training center on April 1, 1957. At that time the population of Santa Maria was slightly more than 13,000 people. Immediately after the activation of Vandenberg Air Force Base, the city was jolted into a frantic burst of activity. The town mushroomed almost overnight, burst its seams and began spreading in all directions. Five years later, the city has doubled its population (current estimate: 28,800) and the end of this growth is not yet in sight.

Recognizing the increased urgency for highway improvement in this booming area, the California Highway Commission provided right-of-way and then construction funds as early as possible, and the project was advertised for bid in August 1960.

Madonna Construction Company of San Luis Obispo had submitted the

Our New Freeway

The following editorial appeared in the *"Santa Maria Times"* on October 1, 1962

Santa Maria's new freeway is now in operation.

In the mill for something like seven years, it was opened last Friday with appropriate ceremonies in which city, county and state officials participated.

The history of the freeway has been a stormy one, as is often the situation when a city is bypassed.

Initially, the controversy raged around where it should be located—on the east side of the city or on the west side.

Once this was resolved, although not to the complete satisfaction of many, there were other problems. The freeway agreement between the city and the State was a stumbling block for a number of months.

The main points of contention centered around the city's seeking to get more specific in the agreement, as opposed to the generalities in the original proposal. Many hours were spent by city and state officials ironing out the differences.

But finally they were resolved and two years ago work started on the 10-mile project.

Now that it is completed, there will be some interesting points to bear watching.

State officials report it is expected to reduce the traffic count on Broadway, old Highway 101, by about a third. The count formerly was 30,000 vehicles a day. This will be reduced to about 19,000, officials say.

What effect will this have on business in the city?

The State Highway Division has made some extensive studies on this point, and these studies generally conclude that after an initial falloff, business quickly returns to the prefreeway level.

In a growing community such as ours, it is questionable if the effects of the freeway bypassing the heart of the community will be noticeable to any degree whatsoever.

The freeway location on the east side of the community has one valuable aspect. Except for a very few eyesores, it shows a very attractive section of the city.

The attractive residential areas, the well-groomed grounds of Hancock College and Fesler School, and the many attractive vegetable fields will give Highway 101 travelers a favorable impression of our community.

In the not too distant future, Santa Maria's newest industry, Columbia Records, will have its plant in operation along the freeway, another favorable mark for the community.

Summed up, it has been a long wait, but one that was well worth it.



An aerial photo of the Santa Maria Freeway bypass shortly after it was opened to traffic in October, 1962. The view is northward.



BEFORE. Traffic in Santa Maria prior to the completion of the freeway bypass. The view is looking northward.



AFTER. Traffic in Santa Maria after the opening of the freeway bypass in October, 1962.

lowest of seven bids received, $5,606,099.75. The contract was awarded on October 27, 1960, and the contractor began work on the same day.

Major work consisted of excavating some two million cubic yards of material, placing 8½ miles of base and concrete pavement, and building 14 major structures at nine different locations. Two of these structures are long twin bridges spanning the normally dry Santa Maria River. As innocuous as this stream appears in dry months, it is capable of flowing in excess of 10 feet deep from bank to bank. Therefore, in anticipation of this sizeable flow, it was necessary that the twin bridges be approximately 2,100 feet long.

290 Girders Needed

The twin bridges crossing the Santa Maria River used precast, prestressed concrete girders, each of which is 72 feet in length and five of which are used in each span. The contractor utilized concrete pouring pads and metal forms to fabricate a total of 290 girders necessary to complete the structures.

The girders were poured in groups of four and cured and stressed while still on the pouring pads. After stressing, the girders were lifted into place and the pads cleared for the next series of pours. Because of the large number of girders needed, pouring and stressing was nearly a daily ritual throughout the construction contract.

The two million cubic yards of roadway excavation and imported borrow were concentrated in sizable cuts at each extreme end of the project, thereby involving a maximum haul of about four miles, and an average haul of two miles.

To accomplish this major task, the contractor used six rubber-tired scrapers with capacities of up to 40 cubic yards. These scrapers were very rapidly loaded using tandem push tractors, and the material was hauled to embankment areas at speeds up to 35 m.p.h. As expected, some difficulty was experienced in scraper tire damage and wear due to large loads and high speeds; but it was worth the effort in that daily production of 8,000 cubic yards of material was not uncommon.

In general, material excavated for construction of the southern half of the project consisted of very fine cohesionless dune sand. The excavation and placement of this material thoroughly tested the contractor's ability and ingenuity in order to maintain the high daily production necessary. The contractor accomplished this mainly through the use of a piped irrigation-type watering system, and through the importation of clay soils to construct and maintain haul roads.

Anchor-chain Drag Used

The troublesome sandy slopes were satisfactorily finished through the use of an 80-pound-link anchor-chain drag followed by the application of straw, seed and fertilizer for permanent erosion control.

Embankment material used to construct the northern portion of the project was unstable, expansive clays. For this reason, the structural roadbed finish was composed of river-run local borrow, aggregate subbase, aggregate base, cement-treated base and concrete pavement for a total thickness of three feet.

In paving operations, approximately 48,000 cubic yards of concrete pavement were placed using conventional side forms and traveling concrete-mixer methods. Daily production ranged from 1,000 to 2,000 cubic yards. Unusually high daily productions of 1,200 to 1,500 tons were maintained in placing 62,000 tons of asphaltic concrete for mainline shoulders, ramps and frontage roads. This was accomplished through the use of bottom-dump trucks and two self-propelled pavers with pickup attachments.

Another major item of work was the removal of the longstanding existing bridge across the Santa Maria River, considered to be a deterrent to the free flow of the river whose channel had otherwise been confined by the construction of stone-faced levees by the U.S. Corps of Engineers.

This reinforced concrete bridge, 1,370 feet long, consisted of 36 short spans, each 38 feet long. Each span was 28 feet wide with four T-girders supported on reinforced concrete pile bents.



BEFORE. Traffic crosses the old bridge over the Santa Maria River prior to the construction of the freeway.



AFTER. These twin bridges now carry traffic on the new freeway across the Santa Maria River channel.



This aerial photo was taken while the twin bridges were under construction. The old structure is to the right.

The contractor "sawed" through these pile bents using an 80-pound-link anchor chain connected at each end to a crawler tractor. Each span was then cut longitudinally with a headache ball and cutting torch, and the halves of the span were dragged approximately 2,000 feet to placement along the north bank of the river for maximum bank protection at minimum possible cost.

Old Bridge Demolished

An older timber bridge with concrete deck, bridging the overflow channel of the Santa Maria River, was also demolished and removed from the right-of-way area.

During construction of the freeway, traffic counts revealed that on Broadway (U.S. 101) in the center of the Santa Maria business district, average daily traffic was 24,000 vehicles. Recently completed traffic studies show that traffic volume on Broadway has been cut by 5,000 vehicles per day as a result of freeway construction. This reduction in traffic volume includes most of the heavy trucks that previously had to use Broadway. They are now using the best possible truck route, which is on the freeway bypass.

The lesser traffic volume combined with the nearly complete elimination of truck traffic through town has relieved traffic congestion in the City of Santa Maria to a very significant degree.

These traffic studies revealed that traffic required approximately 20 minutes to get through the City of Santa Maria prior to completion of the freeway bypass. Traffic using the freeway bypass is now able to cut to less than half the former required travel time.

The major portion of the project was opened to traffic on September 28, 1962. All finishing touches were completed by November 1.

Planning and design was accomplished by District V personnel under former District Engineer A. M. Nash. The contractor was represented by Superintendent Milton J. Gracia. Construction inspection of the project was under the direction of District Engineer E. R. Foley, Assistant District Engineer G. Wofford, District Construction Engineer R. E. Alderman, and Bridge Representative J. D. Norberg.

Grapevine Grade Accidents Reduced

The conversion of the once-hazardous Grapevine Grade portion of U.S. 99 north of the Los Angeles-Kern county line from four-lane highway to eight-lane divided freeway has substantially reduced injuries and fatalities.

A recent study by the Division of Highways comparing accident statistics for an average of the two-year period before freeway construction with the year ending in June 1962, found a two-thirds reduction in accident frequency as well as severity and an 89-percent reduction in fatality rates despite a 10-percent increase in average daily traffic.

The number of accidents dropped from 114 to 41, over 70 percent of the latter attributable to abnormal physical conditions of drivers, defective vehicles and bad weather. More than half the accidents on the freeway involved only one vehicle.

Injuries were reduced from 77 to 25 and fatalities from eight to one—an intoxicated pedestrian.

For several years prior to the construction of the freeway, one of the greatest hazards on the steep, 6-percent grade was the problem of runaway trucks. Nine such accidents occurred in the average of the two years preceding freeway construction, as against one in the post period covered by the study.

Overtaking accidents of all types were most dramatically lessened with rear-end accidents reduced from 59 to 16. Highway engineers credit part of this improvement to reserving some of the right-hand lanes for the exclusive use of slow-moving trucks.

Conversion of the 6.6-mile highway section to eight-lane freeway, completed in July 1960, at a cost of $7,430,000, has made accident rates comparable to other rural freeways throughout the State.

In a letter to Bradford Crittenden, Commissioner of the State Highway Patrol, Womack expressed appreciation for co-operation in providing accident data and for the patrol's excellent job of enforcement and surveillance on the new freeway.

Cable Spinning

Terminal Island Bridge Suspension Cables Completed

By JOHN B. POPPE, Assistant Resident Engineer



Early in December 1962 the spinning of cable wires was completed for the Vincent Thomas Bridge connecting San Pedro and Terminal Island. Stretching over 3,050 feet from anchorage to anchorage, climbing 360 feet to the tops of the towers and gracefully sweeping 215 feet above the water, the twin suspension cables wait to support the steel and concrete roadway which will carry the traffic across the channel of the Los Angeles harbor.

Two 13⅜ inch diameter suspension cables carry to the supporting towers the entire dead load of the 1,500-foot main span and a portion of dead load of the two 506-foot side spans. During periods of maximum load, each cable will be stressed to slightly more than 9,600,000 pounds. To carry this large force, each cable is made up of 4,028 cold - drawn, high - strength wires, placed in parallel. The spinning of these parallel wires was begun on September 17, 1962, and was completed on December 3, 1962.

Preparation Necessary

A considerable amount of preparation was necessary before the first wires for these cables could be placed. On June 18, 1962, John A. Roebling's Sons, subcontractor to the Kaiser Steel Corporation, began erection of the catwalks which crossed the channel and provided the work platform for



THE CATWALK. The photo shows the four supporting cables, wire mesh, wood cleats, two side cables and side wire mesh.

the cable spinners. Each of the two catwalks was supported by four one-inch diameter steel strand bridge cables over which heavy chain link mesh was placed. Wood cleats at two-foot centers were fastened on top of the mesh to provide stiffness and a sure footing for the steep sections of the catwalk.

Two additional cables served as handrails and helped support the catwalk through connecting posts at 40-foot centers. A side mesh of wire fabric was fastened to these vertical posts to increase the safety of the walk. In addition, a system of tiedown or storm cables was used to prevent excessive sway and deflections during high winds.

Roebling predetermined the necessary lengths of these catwalk strands to reach from anchor to tower, tower to tower, and tower to anchor. The strands for the side spans were unreeled on the ground, lifted up to their positions from the anchors, over the cable bents, and up to the towers. Two of the strands for the main span were taken across the channel by barge and lifted in place from tower to tower. The remaining strands for the main catwalk span were then highlined across the channel, using these first strands for support.

Mesh Sections Hoisted

After support strands for the catwalks were positioned, a series of double chain link mesh sections, each 3 feet wide by 100 feet long, was hoisted in rolls to the tower tops. The ends of the wire mesh sections were fastened in position loosely for sliding along the supporting strands and then about 10 feet of mesh was slid out from the tower. A wooden clamping beam was then fastened loosely in place and more mesh was slid out. At intervals, handrail beams and steel tramway suspender beams were fastened on in place of clamping beams. After the chain link sections had been slid and pulled for 1,500 feet between the two main towers and from the towers to anchorages, the clamps were tightened to hold the mesh securely in place.

Construction of the tramway then followed. The tramway is similar to a chair lift ski tow except that, instead of several chairs, only the spinning wheel is pulled along the tramway rope. The tramway was constructed of two additional lengths of bridge strand for each of the two main cables and was supported by spinning towers located on top of the main bridge towers and bents. In the spans, the tramway was held down parallel to the catwalk by steel suspender ropes.

Unreeling Area

During the catwalk erection, work was also progressing on preparations for the wire unreeling area. Here were installed eight vertical axle drums, or swifts, from which the wire for the cables was unreeled. Ordinarily, suspension bridge wire is manufactured from billets and drawn into coils weighing about 600 pounds (in this case about 6,000 lineal feet). Several coils are then spliced together and wound onto drums holding about 8,000 pounds of wire. The wire would then be unreeled from these drums during the spinning of the cable. On this project, Roebling eliminated this step by unreeling during spinning directly from the wire coils.

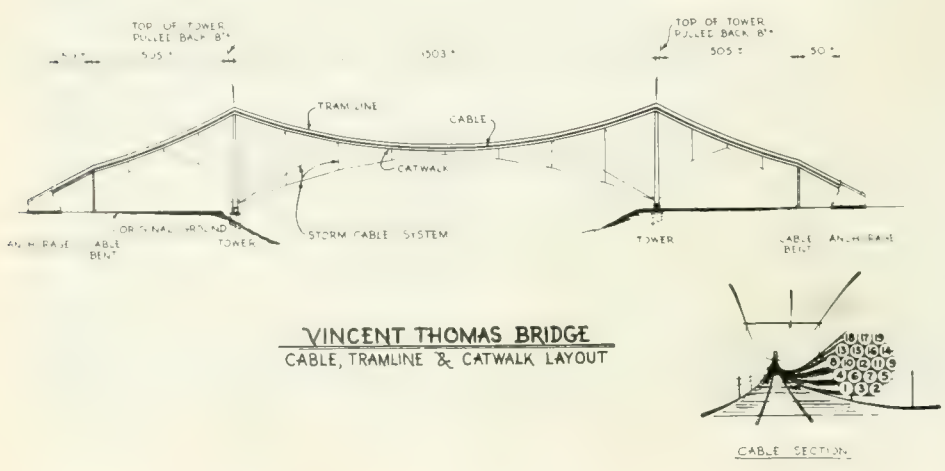
They, in effect, brought the factory to the job. Eight vertical axle drums, or swifts, were installed. Since only four wires were pulled across at one time, four swifts were available for loading during trips. The first coil placed over the swift came to rest on the flange at the bottoms, then as each new coil was loaded onto a swift, the bottom end of that coil was spliced to the top end of the previous coil so that a continuous length of wire of up to 36,000 feet could be drawn off each swift before reloading.

Splices were produced by inserting the ends of wire to be connected into a ferrule, a metal sleeve about two inches long and containing a threaded, hardened metal insert. An internal stop positioned the wires so that each end penetrated to the center of the ferrule. The ferrule was then pressed in an electrically powered hydraulic jacking machine equipped with dies which reduced the diameter of the ferrule by 10 percent.

Both the splicing machine and the ferrules were manufactured by Cables Covers, Limited, of England. This reduction was produced by over 75 tons of force from the splicing machine and caused the hardened metal insert to grip the wire and the sleeve so firmly that the splice proved to be stronger than the original wire.

When the wire had been nearly drawn off one swift, the end from that swift was spliced to the beginning of the loaded companion swift so that a never-ending length of wire was available to construct the cables. Periodically sample splices were made from the machine and tested to failure. In no case was there a failure within the splice.

A tower between the swifts and the tramway was constructed for the support of floating sheaves. This consisted of four sets of double sheaves, located about 50 feet up, and four more sets near the ground level. The wire from the swifts passed over the top sheaves and down under those at the bottom to form a giant loop. When the wire was pulled across the bridge, the wire



VINCENT THOMAS BRIDGE
CABLE, TRAMLINE & CATWALK LAYOUT



PHOTO ABOVE. Looking east from the top of the Terminal Island cable bent. After the wires are pulled along the bridge from anchorage to anchorage, they are tested for sag from the guide wire and then positioned one by one in the large steel tower shoes. PHOTO BELOW. This picture, taken at the Terminal Island anchorage, shows the splay of the cable strands from the splay casting at the top of anchorage to the circular strand shoes at the bottom. This portion of anchorage will be boxed in with concrete.





PHOTO ABOVE. The picture shows a single wire being reeled from a swift to one of the top sheaves of the floating sheave tower. PHOTO BELOW. Looking east from near the top of the Terminal Island tower, several of the 19 strands have been spun. The 19 strands will be squeezed into one compact cable 13⅝ inches in diameter, then after full dead load from the supported roadway below has been imposed the cables will be tightly wrapped with galvanized wire and painted.



tension would cause the lower set of sheaves to rise and ride suspended on this giant loop. This absorbed the shock of starting before it could be transmitted to the swifts, permitting the swifts to start slowly and smoothly. It also gave time to stop the swifts when the tramway stopped and the floating sheaves slowly dropped.

Result in Savings

This whole process of spinning direct from swifts saved not only the work and equipment of unreeling onto drums but saved a considerable amount of heavy equipment that would have been needed to start and stop the heavy reels.

Position Determined

Before spinning can be started, it is necessary to determine the position that the cable must take in its unstressed condition so that as the total structure load is applied, the cables and roadway will deflect to the dimensions and elevations as planned for the finished structure. The cable takes the shape of a catenary in its initial position of supporting only its own dead weight. By working back from the final dimensions and elevations to the initial catenary dimensions and elevations, it is possible to calculate the elongation that will take place in the cable due to the applied dead load of the structure.

As the load is applied to the cables, their sag increases and also the cable supports at the top of the towers move in. The vertical deflection of the cables at the center of the main span, from their spun position to their final position, is 12.08 feet and the span length between towers reduced from 1,503 feet to 1,500 feet by the deflection of each tower 1.50 feet toward the channel.

To determine the change in length of cable from its free cable condition to its fully loaded condition, many things must be considered. For instance, for any one loading condition the horizontal force in the cable is constant, which means that the cables at the towers exert only vertical or axial loads on them. Since the horizontal pull on the cable is constant, the tension in the cable must vary with every change in slope. The slope of the cable approaching both sides of each tower is nearly the same so that friction in the saddle both during construction and in the final structure is sufficient to prevent slipping. The load on the back stays and anchorage produces further elongation which must be considered.

Calculation Made

Calculation must also be made for changes in temperature which cause variations in cable length and variation in tower position must be considered. In the main span, for instance, calculations indicate that a difference in the horizontal distance between the towers of 1″ results in a variation in sag of 2″±, and in the side spans a difference in the horizontal span length of 1″ results in a variation in sag of 7″±.

The length of cable from anchorage to anchorage was calculated to be 3,053.6 feet in its unstressed, no-load condition. As the structure is completed and the cable is subjected to the full dead load forces, calculations show that it increases in length 67 inches to 3,059.2 feet. From these calculations, the locations of the guide wires can be determined.

Surveyed Into Position

Two guide wires, one on each side, were then surveyed into the exact position that this theoretical caternary should take. The survey was made at night so that changing temperatures would have the minimum influence on the wire lengths and tower positions. The guide wires furnished for this survey had previously been loaded to the calculated stress of the finished elongated cable, and while in this loaded condition, marked with the correct cable lengths. These marks were positioned at the centers of the saddles before the wire was surveyed. This mechanical means of accounting for the effect of changing from the loaded cable to the catenary agreed very closely with the survey results.

After positioning of the guide wires, the cable spinning was started by leading four wires from the swifts, through the floating sheaves, under the strand shoes which hold the wire at the anchorage, and then onto the bridge where the ends were fastened at a convenient place. The wires were then looped up near the strand shoes and over the spinning wheel ready for a trip across the bridge. When the tramway was started, the wheel moved off, pulling the wire up from the swifts, over the top of the wheel and laying the wire along the catwalk. When the wire reached the other side, the loop pulled across by the wheel was removed and placed around the strand shoe at that anchor. The wires then started at the first anchor, passed around the strand shoes there, continued across the bridge to the second anchor, around the strand shoes and back across the bridge and down to the swifts. The wheel was taken back empty to the first anchor, and the wire leading back to the swifts was passed again under the strand shoes and over the wheel, and a second trip begun.

The two main 13⅜-inch cables were constructed of 19 separate strands, each strand containing 212 wires. These wires were individually adjusted to the same approximate sag as the guide wire as they were brought up into the strand. When the first strand of 212 wires was completed, it was then surveyed into position in the same manner as had been done with the single guide wire. Subsequent strands were adjusted to match this control strand.

Cables Built Concurrently

Both cables were constructed concurrently. A layer of strands on one cable was completed, and then a corresponding layer was constructed on the opposite cable while the strands of the first cable were prepared for adjustment. By this means, the forces on the supporting towers were kept reasonably equal and both cables were ready for use at nearly the same time.

After all strands for a cable were completed, the entire group is squeezed into one compact cable 13⅜ inches in diameter. The next step is to hang suspender ropes from the cables for support of the trusses and roadway below. These suspender ropes are looped over and seated in preformed grooves in large split castings tightly bolted to the main cables by high strength bolts.

Wrapping of the two main cables is not started until after the full dead



This aerial photo, looking southwest, shows the bridge under construction with the catwalk and partially completed cables suspended between the towers.

load of the roadway deck system has been applied.

Work Started

Work on the 16½-million-dollar project was started in May 1961. The substructure contract was let to Guy F. Atkinson Company and was completed in July 1962. Guy F. Atkinson Company also has the contract for the approach roadwork leading to the bridge on both sides and including the toll plaza and administration building on the Terminal Island side. The largest contract for the superstructure was let to Kaiser Steel Corporation. The erection of the towers was sublet to Yuba Erectors and the manufacture and spinning of the cables to John R. Roebling's Sons. The project is scheduled for opening to traffic the latter part of September 1963.

The bridge was designed by the State of California, Division of Highways, Bridge Department, with W. J. Jurkovich in charge of design and J. M. Curran, Resident Engineer, in charge of construction.

FOREST HIGHWAY FUNDS ALLOTTED STATE

The California Division of Highways, U.S. Forest Service and U.S. Bureau of Public Roads, have jointly announced the allocation of federal forest highway funds for California for the fiscal year which begins July 1, 1963.

Funds were allotted for the following construction projects:

$850,000 to Forest Highway Route 6, Beegum-Peanut Highway, Trinity County, for grading of 4.5 miles of State Sign Route 36 between the Trinity county line and 4.5 miles west.

$690,000 to Forest Highway route 7, Mendocino Pass, Glenn County, for clearing and grading 7 miles of county road between the forest boundary and 7 miles west.

$500,000 to Forest Highway Route 35, Calaveras County, for grading (portion) and surfacing of 5.8 miles of State Sign Route 4, Ebbetts Pass Highway, between Dorrington and 5.8 miles east.

$550,000 to Forest Highway Route 39, Tuolumne County, for grading (portion) and base on 6.1 miles of State Sign Route 120, between 6 miles east of Pilot Ridge and Yosemite Park boundary.

$1,000,000 to Forest Highway 48, Fresno County, for grading 1.9 miles of State Sign Route 168 between 2.8 and 4.7 miles west of Pine Ridge.

$375,000 to Forest Highway 93, Siskiyou County, for surfacing 30 miles of county road between Cecilville and Callahan. $375,000 work acceleration funds are also available to supplement the forest highway funds.

CITIES GET $9.6 MILLION

The Department of Public Works apportioned $9,651,130 to the 380 incorporated cities in California as their share of the state tax on gasoline.

This apportionment is 1.5 percent greater than the quarterly allotment made last October.

Cliff Face Threat

500 Tons of Granite Hanging Over Major Route Poses Problem



Scene of rock fall area on U.S. 50 near summit of Echo Pass. Two workmen may be seen at top of cliff just to left of base of big tree near brink. Bridge 25-44 in foreground.



About 100 cubic yards of rock broke loose from the cliff above and fell on U.S. 50 just east of Echo Summit at approximately 7.15 p.m., November 10, 1962. Luckily, no vehicles were near at the time.

The road here is virtually carved from a rock face which rises 1,000 feet, almost perpendicularly, from the valley floor. At the point of the rock fall most of this drop is below the road. Maintenance in this area in winter at 7,000 feet altitude, is always difficult.

Nevertheless within two hours after the fall Echo Summit maintenance crews, working in the dark, had cleared a one-way road. By noon of the next day the entire road surface was cleared, and normal traffic conditions reinstituted.

Fearing possible further falls, inquisitive maintenance men inspected the sheer cliff above the highway at this place, and found a crack extending downward along the rock face which threatened to release an even greater fall of rock. Observation over several days showed the crack was opening an infinitesimal amount each day, and that eventually another 350 yards or so of rock would fall.

Damocletian Sword

Rather than leave some 500-plus tons of rock hanging like a sword of Damocles above the road, the Echo Summit maintenance crews, after consultation with District III Headquarters at Marysville, decided to shut off the highway and clear the potential fall before it could do any damage.

This necessitated a detour, but because of the especially rugged terrain, the only possible route was over the obsolete, discarded, Old Meyers Grade road. Before any work could be done on the rock face, it was necessary this route be reconstructed. Even then, due to its narrowness, sharp switchbacks, and steep grades, only radio-controlled, one-way traffic could be handled over it.

A further problem was Bridge 25-44 (Dry Bridge), mentioned in the report below. This bridge, a sidehill viaduct of concrete girder construction over 100 feet long and 24 feet wide which carried the highway around a particularly difficult section of cliff, could be severely damaged should the rock fall land in the wrong place.

Since highway maintenance men are not expected to be "powder monkeys," expert advice from private industry was sought. Rental of private equipment was also necessary, and an emergency allotment of $20,000 was set up for the job.

On the following pages is the highway superintendent's report of how the job was done.

And How It Was Removed

Dynamite, Bulldozers, Expert Advice, Nerve Solve Problems

By E. D. WILLIS, Highway Superintendent

Superintendent's Report

Work on the detour began November 19, 1962 and was completed November 26, 1962.

Due to weather conditions work on the rock formation was delayed until November 28, 1962.

At 9 a.m., November 28, 1962, traffic was routed over the Old Meyers Grade and drilling and blasting operations began on the rock formation.

Truck - and - trailer combinations, overlength loads and single-drive three-axle trucks were restricted on the detour, due to two switchback turns being too sharp to negotiate.

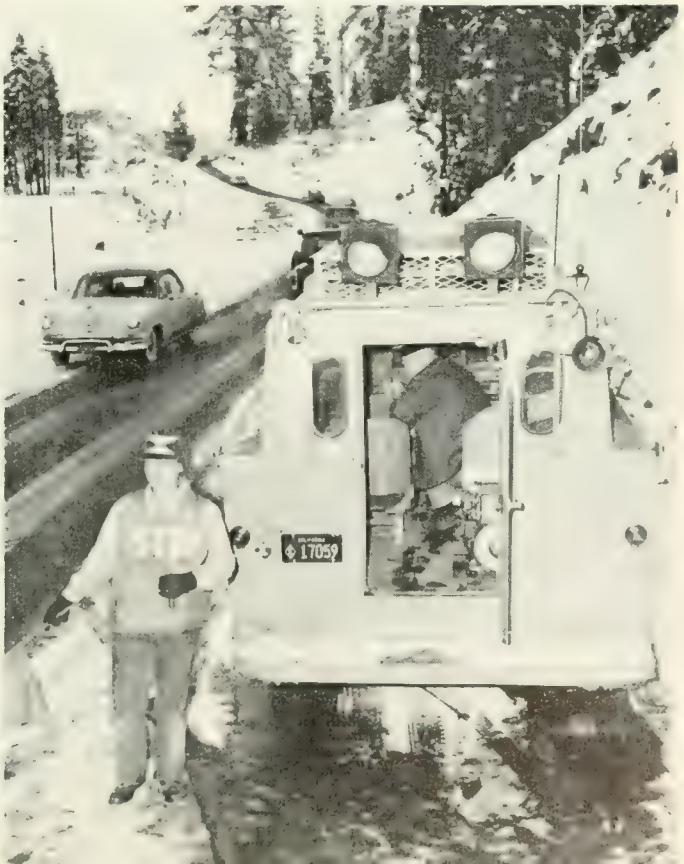
Work was started immediately to widen the turning radius of these turns to accommodate all but overlength loads under normal conditions.



Men working on rim of cliff—note safety lines. Drop here is about 75 feet to highway, nearly a thousand feet more to valley floor. Car parked on closed U.S. 50 may be seen beyond right elbow of upper figure.

Photo at left below shows traffic moving in one-way groups over narrow switchbacks of old Meyers Grade road. Photo at right is highway maintenance truck with portable generator and radio equipment, here at east end of detour in radio communication with west end of detour.







Traffic over detour temporarily halted while grader widens road on one of switchbacks on detour.

Powder Expert Located

During preparations for removing the rock formation, Don L. Calvin, highway foreman, learned of a powder expert in the employ of Granite Construction Company, on location near Woodfords, California.

We contacted the company's project superintendent, Mr. Richard Lewis. Mr. Lewis advised us that he had a very good powderman in the person of Mr. Richard Absher in his employ. We learned that it would not be possible for us to hire Mr. Absher except on Saturday and Sunday because he was needed on his job during the regular workdays. Mr. Lewis volunteered to bring Mr. Absher to Echo Summit on Friday, November 23, for consultation.

Mr. Lewis and Mr. Absher arrived at Echo Summit Maintenance Station at 1 p.m., November 23.

Sand Cushion on Bridge

Mr. Absher surveyed our problem, then suggested steps to follow to accomplish the rock formation removal with the least possibility of damaging the Bridge No. 25-44. If surrounding rocks were loosened it was feared they might become dislodged and damage this bridge. A cushion of sand was placed on the bridge deck to prevent damage from falling rocks caused by blasting.

After consultation with Mr. Absher, Foreman John J. Montgomery felt he could accomplish the rock removal, with advice from Mr. Absher.

Mr. Lewis advised us that Mr. Absher would be available to use anytime during the workday for consultation only, so that a minimum amount of time would be spent away from his job. I expressed to Mr. Lewis our appreciation for their advice and the valuable time he and his man spent helping us with this unique problem.

Foreman John J. Montgomery, Lawrence W. Pearce, highway maintenance man III, and Merlin Winji (contractor operator), started drilling operations on top of the rock at 9 a.m., November 28.

Workers Wear Safety Lines

It was necessary for these men to secure lines and wear safety belts for this operation. I feel these men are to be commended for their special service to the Division of Highways for volunteering to place themselves in danger by standing on this loosened rock formation to drill holes to place dynamite. There was a possibility that the action of the jackhammer would cause this rock formation to fall from under their feet, especially after blasting had begun.

To keep from loosening nearby rocks, damaging Dry Bridge, and nearby summer cottages, the drilled holes were loaded very light. Holes were drilled from 2 feet to 6 feet in depth. In the first series of five holes, five pounds of powder was used. This charge broke approximately 10 cubic yards from the top and front of rock.

Weapons for avalanche control this winter at Echo Summit are threefold; (1) a jeep-mounted 105-mm recoilless rifle manned by the California National Guard (2) a 75-mm recoilless rifle manned by the U.S. Forest Service when necessary in the Frog Pond-Flagpole Curve vicinity on the east side of the summit and (3) a new device called an "Avalauncher" which is something like a high-powered baseball thrower.

All these devices are for destroying cornices which threaten to become avalanches, before they become dangerous. The "Avalauncher," which fires an explosive shell somewhat like a trench mortar shell, is a smaller, more easily portable device for use against smaller cornices. It will be manned by Division of Highways crews trained by Monty Atwater of the U.S. Forest Service.

On the second series of holes a proportionate amount of powder was used, resulting in 20 cubic yards removed. A loosened surface condition resulted and it become necessary to set individual charges to clean up the surface in order to drill another series of holes. Footing for the drillers was very limited up to this point. Although light snow fell almost all day November 28, these men continued drilling and blasting operations.

Mass Lets Go

The surface of the rock at this time was below ground level with a larger

Portion of the some 500 tons of granite dropped by final charge November 29th. Further blasting was necessary to break pieces small enough for bulldozer to handle. (Photos by Robert Dunn)



surface area to drill. This third series of four holes was loaded with 17 sticks of 40 percent dynamite, and detonated at 11.45 a.m., November 29. All concerned were relieved to learn that this charge loosened the remainder of the rock mass and caused it to fall to the highway below, well clear of Bridge 25-44.

We now had 300+ cubic yards of rock to remove. The D-8 tractor dozer, 3 cubic yard loader and compressor were moved in immediately to begin cleaning the roadway. A 12-foot roadway was cleared by 4.45 p.m., November 29. Due to the condition of the road surface and time involved to change the detour it was decided to allow all vehicles which had been restricted on the detour to use this roadway, so restrictions could be lifted.

Clear on November 30

Removal work was resumed at 8 a.m., November 30, and by 11 a.m. all rocks were clear of the roadway.

The falling rock masses caused extensive damage to the road surface and base. The remainder of the day was spent restoring the roadway. All necessary repairs were completed by 3.30 p.m., November 30, at which time the road was opened to all traffic.

Construction Index Shows Marked Drop

The California Highway Construction Cost Index for the fourth quarter of 1962 stands at 232.6, a decrease of 56.5 points or 19.5 percent under the third quarter of 1962, returning the index to the level of 1960 and 1961. However, none of the larger projects used for the index computation in the fourth quarter is located in mountainous terrain, where the cost of highway construction is usually higher.

The index for the year 1962 has been computed at 256.2, 17.1 points or 7.2 percent higher than the figure for the year 1961.

The number of bidders per project during the fourth quarter averages 6.1, an increase of 1.6 over the previous quarter.

Luddy, Woolley Reappointed to Highway Commission



ARTHUR T. LUDDY



ROGER S. WOOLLEY

Governor Edmund G. Brown announced on January 17, 1963, the reappointment of Arthur T. Luddy of Sacramento and Roger S. Woolley of San Diego to four-year terms on the California Highway Commission. Both men were first appointed in 1959.

Luddy, who served as vice chairman of the commission in 1962, is an executive of the California-Western States Life Insurance Company. His interest in highway matters has grown in part out of his extensive travels about the State as an insurance man during the past 40 years.

He has been active in civic affairs in the Sacramento area, including a term on the city planning commission. He is also prominent in Catholic circles and was recently made a Knight of St. Gregory the Great.

Woolley is an attorney whose home is in Rancho Santa Fe. He had been a member and officer of the San Diego Highway Development Association for several years prior to his original appointment to the commission.

A native of Chicago, Woolley was educated at the College of William and Mary, London University, and the Columbia University Law School. He served in the U.S. Navy in World War II.

IN MEMORIAM

Bridge Department

Milton C. Kjer, bridge construction inspector II.

District III

Floyd E. Byars, highway engineering technician I.

District IV

Edward Leong, assistant highway engineer.

Rolf W. Sollie, engineering aid II.

L. Albert Weymouth, principal highway engineer.

District X

Kermit M. Cagle, drawbridge operator.

Shop 2

Gerald M. Sindorf, heavy equipment mechanic.

State-owned Toll Bridges

Arthur Fross, toll bridge electrician.

Albert A. Mellis, highway maintenance man II.

APR 18 1963

Big Bear Road

'Arctic Circle' Section Widened to Four Lanes

By L. M. BARNETT, District Construction Engineer, and
J. L. RIDDELL and W. McKNIGHT, Resident Engineers



On September 12, 1962, the last of three contracts was completed between Lakeview Point and Big Bear Dam, expanding from two to four lanes the 5.4 miles of highway that is locally referred to as the "Arctic Circle."

Big Bear is one of the most popular resort areas in Southern California and is accessible by three main routes: State Sign Route 18-30 from San Bernardino Valley, SSR 38 from Redlands via Mill Creek Canyon and Barton Flats, and SSR 18 from Lucerne Valley on the desert side.

The Big Bear Lake valley recreational area, 90 miles from the vast Los Angeles metropolis, was not being adequately served by the existing two-lane highway. The most treacherous portion of this highway was between Lakeview Point and Big Bear Dam, where the number of vehicles in one direction oftentimes exceeds 600 per hour. It was constructed in 1926 on the precipitous mountain terrain as a narrow, twisting two-lane road and remained in that condition until the first of three major improvement projects was started in 1957.

Since that time, three contracts have been completed providing four lanes of undivided roadway all the way along the "Arctic Circle." On the old winding two-lane road, it was almost impossible for anyone to overtake a slow-moving vehicle for the whole 5.4 miles. Passing maneuvers are now possible throughout the area.

Adverse Weather Conditions

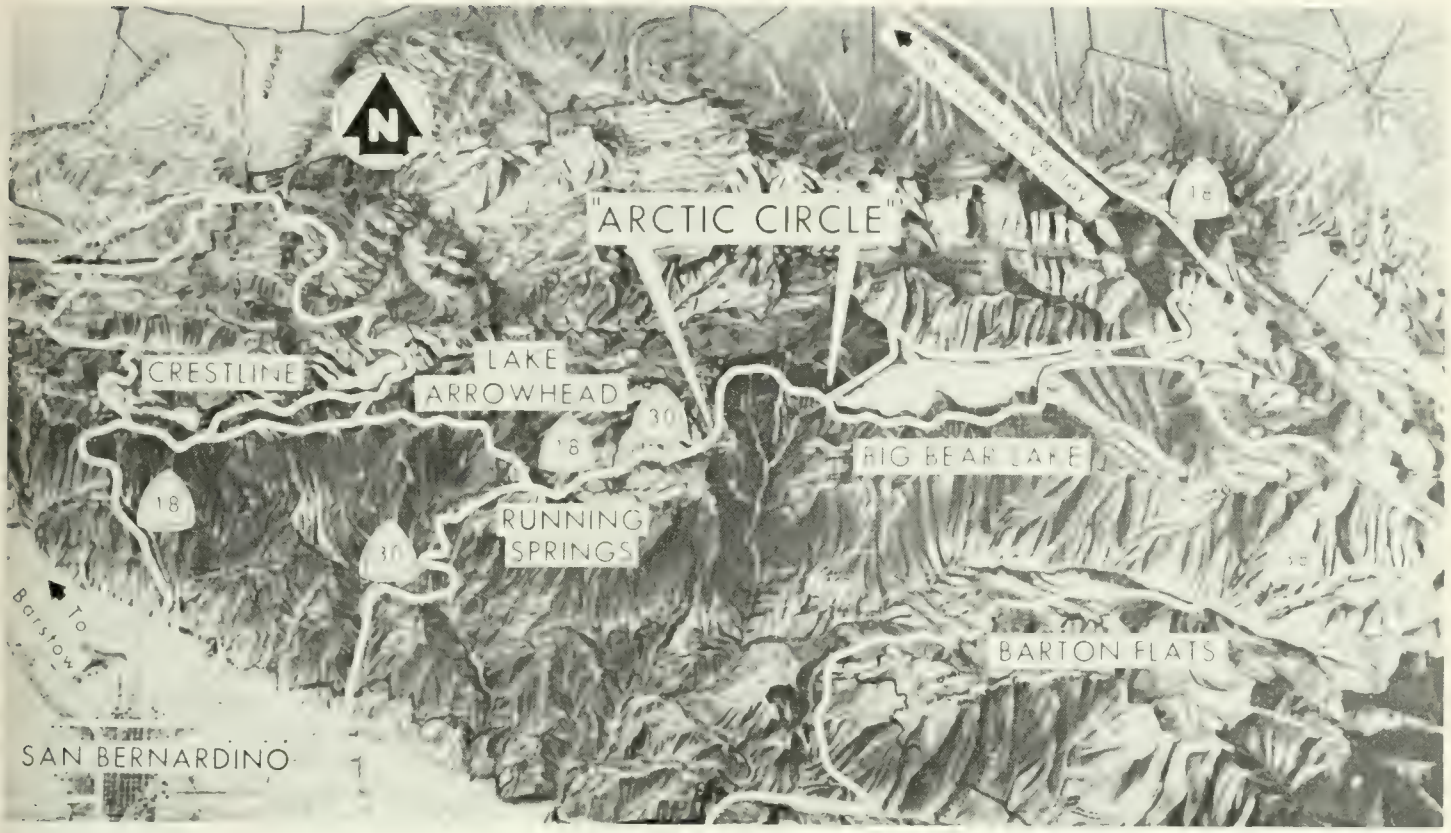
The last two contracts were started in January and February of 1962. The day after the first bids were opened, it began to snow and continued until over five feet had accumulated. This



Construction equipment widens the two-lane ledge section of the Big Bear Highway.



A crew completes paving of the fourth lane on the new widened portion of the Big Bear Highway.



A topographic map of the Big Bear Lake area showing the location of the "Arctic Circle" section of Sign Route 30 on which the construction work described in this article took place.

was the beginning of extreme storm conditions. The area was receiving its heaviest snowfall in years.

Normally the contractor would not attempt to work under conditions as adverse as these. (He would be compensated with working days at the end of his contract.) However, these two contracts were different in that they had a middle-of-the-job requirement that the road could, under no circumstances, be closed to traffic after June 14. This opening requirement was compelled by the large additional tourist traffic that moves into this resort area after school vacations begin.

Early Opening Date

This early opening date meant that the contractors had to substantially complete the major grading by that time. So, snow or no snow, they moved in with their equipment and started clearing and excavating. Approximately 770,000 cubic yards of earth and rock had to be excavated and compacted in embankments within the tight time schedule. At one time, there were 29 dozers, four large shovels, two large rubber-tired loaders, and 44 trucks on roadway excavation working 12-hour shifts all within the confined limits of their project.

Surveyors Overcome Obstacles

It was much easier, however, for this heavy equipment to push through the deep snow than it was for the surveyors. Nevertheless, since the equipment operators had to have slope stakes for a guide, the arduous task of trying to shinny up the precipitous snow-covered slopes was started. Even during fair weather conditions, these prodigious mountains are a challenge to a surveyor's ruggedness and ingenuity. The rocky mountainside from which the road is carved is near vertical. The cuts extend up to 120 feet and the fills down to 300 feet. In setting slope stakes, the surveyors often had to be supported with ropes.



Surveying in snow country. A member of the party signals the others that he has finally found the "catch point" they have been looking for.

Surveyors Versatility

Southern California surveyors are normally more accustomed to adapting themselves to the flat valleys and extremely hot desert areas. However, they demonstrated their versatility in adjusting to this extreme change in climate and terrain. By donning earmuffs, mittens, and loggers' boots they were able to combat the heavy snows and steep cliffs and keep ahead of the contractor's operations. In order to relocate and find previously set survey points, it was often necessary to dig through five feet of snow and ice,



Looking out across Big Bear Lake from the east end of the road widening job.



A portion of the new four-laned "Arctic Circle" section of Sign Route 30.

often only to find the same point completely covered by fresh snow on the following day. At one time, eight survey parties were used placing clearing lath and slope stakes in order to insure that the contractor was not delayed.

Springs Used for Fountains

Several springs were encountered which threatened the stability of the highway. These springs were harnessed by installation of spring boxes and then put to good use by piping the water to various scenic lookout points. Rock drinking fountains were constructed at these locations to provide mountain spring water for the tourists.

This improvement is located within the limits of the San Bernardino National Forest and was constructed under United States Forest Service permit. U.S. Forest Service officials co-operated with the State of California in this improved roadway.

The second unit, built by Matich Constructors, was completed on August 18, 1962, and the third unit, built by the E. L. Yeager Company, was completed on September 12, 1962.

Heavy snow and slides will continue to be a problem along this section of roadway. However, the additional width and the improved alignment will now afford sufficient room in which to handle the snow and slide material without closing the road or seriously hampering the flow of public traffic; and, most important, the vacationer will no longer be annoyed by having to poke along behind a slow-moving vehicle.



TIMES PAST. Snow removal operations on the Big Bear Road. The year is 1930.



Preparing the Big Bear Road for oiling. The year 1928.

Department Awards Record Landscape Job

The largest state highway landscaping contract in its history, $424,230.87, for trees, shrubs and ground cover on 4.8 miles of the Golden State and Glendale Freeways in Los Angeles, has been awarded by the State Department of Public Works.

In awarding the contract to the K.E.C. Company of Artesia, State Director of Public Works Robert B. Bradford pointed out that in the last few years the California Highway Commission has been budgeting about $4,000,000 a year for landscaping and other planting.

The contract awarded today involves installing an irrigation system and planting 2,660 trees, 32,000 shrubs and 622,400 ground cover plants.

The work will extend for about 3½ miles along the Golden State Freeway (U.S. 6-99), between the Los Angeles River crossing near Elysian Park and Glendale Boulevard; and a little over a mile on the Glendale Freeway, including the complex interchange connecting the two routes.

Tehachapi Job

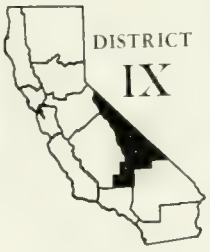
More of U.S. 466 Now 4-lane Freeway

By CHARLES H. JACKSON, Resident Engineer





PHOTO ABOVE. During the earlier construction phases of the project flagmen handed out leaflets explaining the reasons for traffic delays ahead. BELOW. View of completed roadway. Note concrete lined ditches above cuts to prevent erosion.



Transformation of U.S. 466 in eastern Kern County from an inadequate two-lane cross-state lateral to a modern four-lane freeway has taken another major step forward with the completion of 5.8 miles through rugged mountain country west of Tehachapi.

The new section, extending from Caliente Road about 27 miles east of Bakersfield to Keene, was opened to traffic on October 30, 1962.

It serves as an extension of the 12-mile foothill section of U.S. 466 to the west which was completed by District VI in December 1960, and described in the March-April 1961 issue of *California Highways and Public Works*.

The next step will be construction of a 7.6-mile section eastward from Keene to near the west city limit of Tehachapi. The California Highway Commission included $4,100,000 for the first unit of this project, the grading, and work is expected to start this spring.

Route Is Major Link

This route, known as the Tehachapi Highway in Kern County, is a link in a major transcontinental highway. Heavy traffic on this route includes a large percentage of trucks and out-of-state traffic as well as local traffic.

This new section of freeway begins about 27 miles east of the City of Bakersfield and ends some 10 miles west of the City of Tehachapi. Throughout its length it traverses difficult terrain of the Tehachapi Mountains.

The new 5.8-mile, four-lane, 60 m.p.h. full freeway replaces a facility which had become inadequate for today's traffic. Deficiencies of the pre-

vious facility were narrow width of pavement, long steep grades, winding alignment, restricted sight distance and lack of capacity due to slow-moving vehicles.

Only Feasible Line

The only feasible line of development for the new freeway was along the line of the existing facility so the existing highway was utilized wherever possible. Deviation from the original alignment was made where necessary to obtain acceptable line and grade standards.

The old highway had 23 curves ranging in radius from 600 feet to 3,000 feet; 10 of these curves had radii of 1,000 feet or less. Maximum grade was 6 percent on a total length of 2.6 miles. The longest sustained 6 percent grade was 1.2 miles in length.

The new freeway ascends the slopes of the Tehachapi Mountains from elevation 2,084 feet to elevation 2,732 feet. Grades vary from a minimum of 0.25 percent to a maximum of 6 percent. The lone 6 percent grade is 0.6 mile long. There are 3.3 miles of grade varying from 3.15 percent to 5.50 percent. About 54 percent of the alignment is on tangent. There are 19 curves with radii varying from 1,200 feet to 15,000 feet.

During the grading phase of construction the contractor was required to permit public traffic to pass through the work with as little delay as possible. During pioneering and blasting operations traffic could not be permitted through the work areas. Scheduled two-hour traffic delays were placed in effect during this period. Signs were posted to give public notice of these delays. Radio, television and newspapers were used to keep the public informed. Handout leaflets, describing the work in progress and giving reasons for the detaining of traffic, were given to people stopped during traffic control.

Water in Short Supply

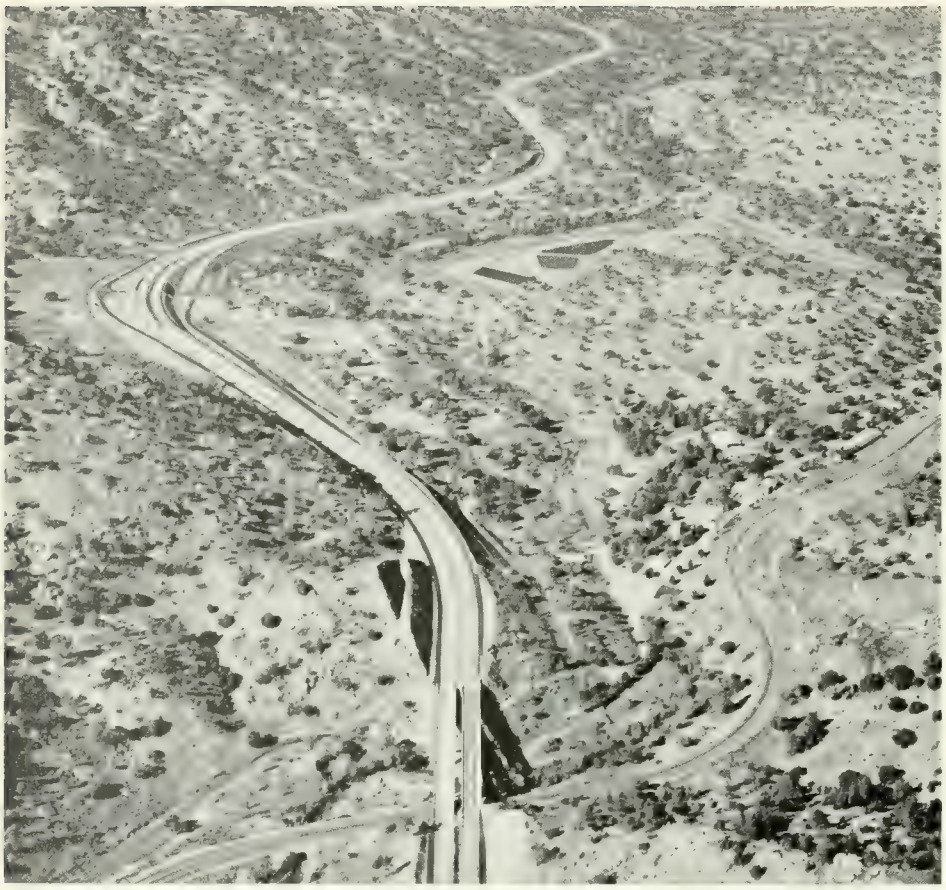
Water for construction purposes was in short supply locally. Reservoirs were built to impound water from Clear Creek. However, this source supplied an insufficient quantity at best; the creek dried up entirely dur-



New plate girder bridge at Tehachapi Creek during construction. County road under first span, railroad under third span and creek between.



Benched cut and heavy fill partly completed. Note steep haul roads in rugged terrain.



Looking westerly from end of project. New Tehachapi Creek Bridge on left in foreground and Keene Interchange in left center.

ing summer months. The main source of water was a well just west of Tehachapi. A pump at the well sufficed to overcome a short lift to the nearby summit. From here gravity flow was possible along the 9.5 miles of pipeline to the end of the project. Vibratory compactors were used in construction of embankments. In the granular soils encountered on this project vibratory compactors were able to achieve specified compaction without the addition of water. This eased the problem of water supply considerably.

During the winter of 1961-62 the project was plagued with too much water. Fog, rain, hail and snow forced work stoppages and made travel difficult. However, during heavy storms the route was kept open to traffic even when other routes in the Tehachapi Mountains without construction zones were closed.

Largest Single Item

Roadway excavation was the largest single item of work on the project. Construction required 1,950,000 cubic yards of roadway excavation. About 700,000 cubic yards were drilled and shot. Many of the cuts were deeper than 100 feet; maximum cut was 280 feet. Maximum fill was 200 feet. Steeply sloping hillsides made access difficult. Pioneering, excavating and hauling were often hazardous. It is noteworthy that in spite of the peril inherent in heavy construction through difficult terrain, work was completed without serious injury to contractor's personnel.

The alignment crosses numerous steep channels which carry runoff from the northerly slopes of the Tehachapi Mountains to Tehachapi Creek Canyon. Some 10,500 linear feet of corrugated metal pipe, ranging in size from 12 inches to 66 inches, were installed to drain the roadway and maintain the natural drainage pattern. Since native soil is largely granitic and quite erosive, ditches and benches on steep grades were lined with concrete, and energy dissipators were installed at pipe outlets to prevent erosion.

Construction of the project's 11 miles of 24-foot pavement required over 34,700 cubic yards of portland cement concrete. Paving was done with a Guntert & Zimmerman slip-form paver. Alignment, grade, and cross slope of the concrete pavement were automatically controlled. Offset line and grade wires in conjunction with the machine's electronic control probes permitted accurate control of the paving.

Polyethylene Ribbon Used

The longitudinal joint in the monolithically poured 24 foot width of pavement was formed by inserting a polyethylene ribbon (2 inches wide by 0.004-inch thick) in the fresh concrete immediately behind the slip-form paver. This was effective and joints so formed were less expensive than sawed joints.

The basic slip-form paver, with attachments differing from those used in paving, was used to trim cement-treated base. The electronic guidance system was used during this operation. The use of this equipment resulted in a truer section and grade than would have been possible had motor graders been used.

Interchanges were constructed at Hart Flat and at Keene to serve local traffic. Two bridges were built for these undercrossings. A third bridge was built adjacent to an existing bridge at Tehachapi Creek. The existing bridge was sufficiently adequate structurally to permit its inclusion in the new facility.

R. R. Hensler, Sun Valley, was prime contractor for the contract. R. L. Mason was the contractor's general superintendent. The work was done under the supervision of E. R. Foley and C. A. Shervington, District Engineers; J. R. Jarvis, District Construction Engineer; C. H. Jackson and R. M. Kelly, Resident Engineers. Final construction cost was $5,050,000.

San Mateo-Hayward Bridge

By NORMAN C. RAAB, Projects Engineer, Division of San Francisco Bay Toll Crossings

Bids were received on July 11, 1961 starting the overwater construction for the new seven-mile-long, four- and six-lane San Mateo-Hayward Bridge across San Francisco Bay replacing the present substandard two-lane structure which has been in operation since 1929. A 13¼-million-dollar contract was awarded to the low bidder, Peter Kiewit Sons' Company, to construct the first section of this project, a four-lane concrete trestle.

This is the fifth of 16 contracts contemplated for the 70-million-dollar project with consists of: a wide earth fill one-third of a mile in length at the east end of the bridge on which the toll plaza with its administration and maintenance buildings will be constructed; 4⅔ miles of four-lane precast concrete trestle, and two miles of six-lane, high-level steel structure over the navigation channel near the west end of the project.

The contract for the fill called for placing 425,000 cubic yards of selected earth material starting at the east shoreline. The fill, as it progressed westward, was wedge shaped in form, having its two faces at an angle of 30 degrees with the centerline of construction. The weight of the placed material caused the soft bay mud to be displaced seaward. Small blasting charges were employed to keep the mud in a mobile, semiliquid consistency along the working front.

Soft Mud Displaced

It has been estimated from the material placed that 80 percent of the soft mud was displaced; the fill and earth beneath has consolidated over two feet during the first 12 months. It is expected that another foot of settlement will occur within the next two years prior to the construction of the toll plaza.

Recent traffic studies have indicated that a modern four-lane divided roadway would provide ample capacity at the present rate of growth and with the present number of bay crossings until the year 1980.

The new trestle will initially provide for a four-lane divided roadway with provision for expansion to six lanes, when needed, by the addition of two lanes on the north side. This addition would not in any way interfere with traffic using the four lanes. The new single-deck steel structure is being planned for six lanes.

The four-lane trestle consists of four fundamental elements:

- Six, 24-inch hollow prestressed concrete piles per bent.
- Two precast concrete pile caps which are jointed into one during construction.
- Four precast deck sections which are dowelled at one end to the cap.
- Two precast concrete curb and rail units for each side of the roadway.

Other Roads Built

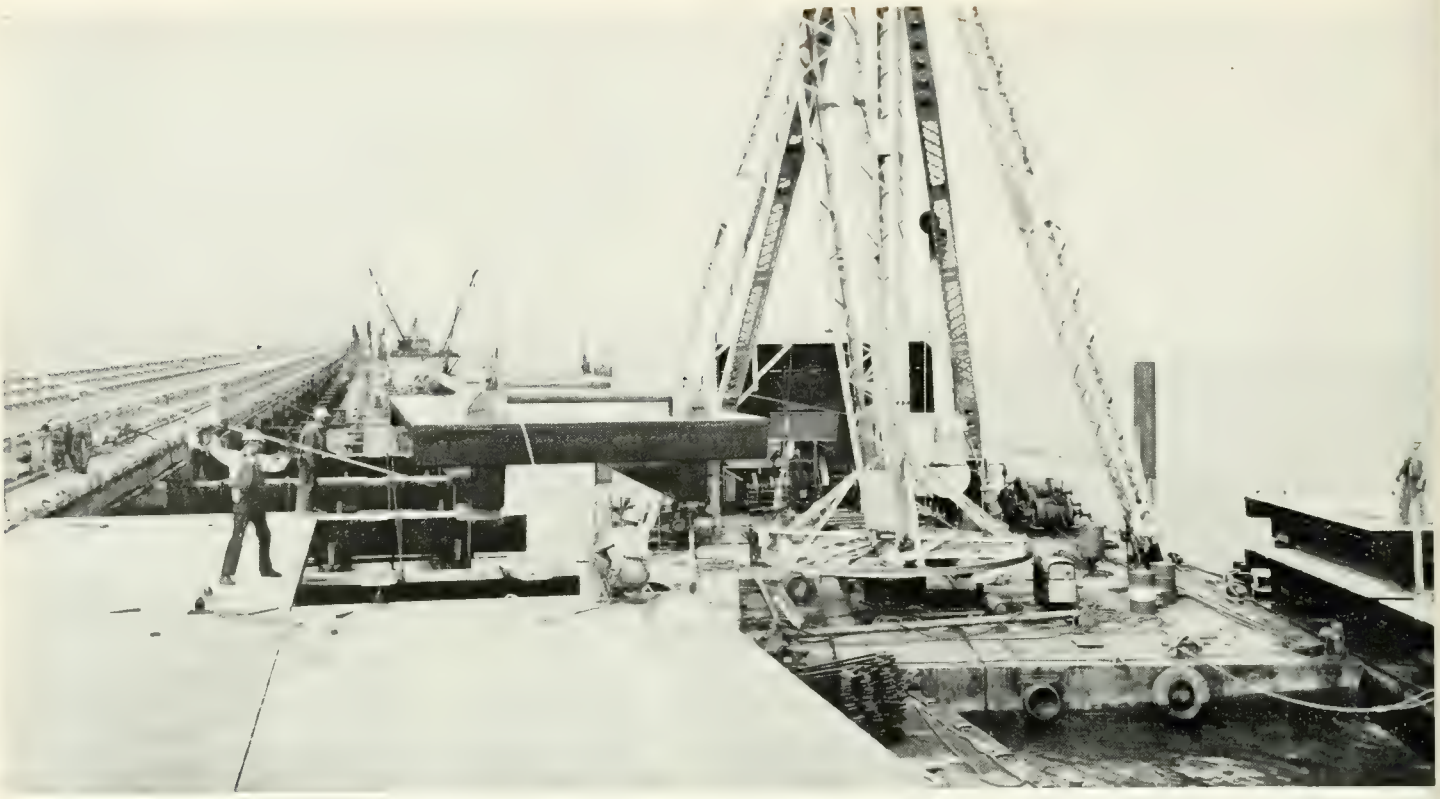
After erection, other appurtenant roadway facilities will be added for the safe and comfortable passage of vehicles.

The contract requires the furnishing of 4,840 piles, 60 to 90 feet in length; 1,620 pile caps; 3,212 deck units; and 47,700 lineal feet of curb and railing units.

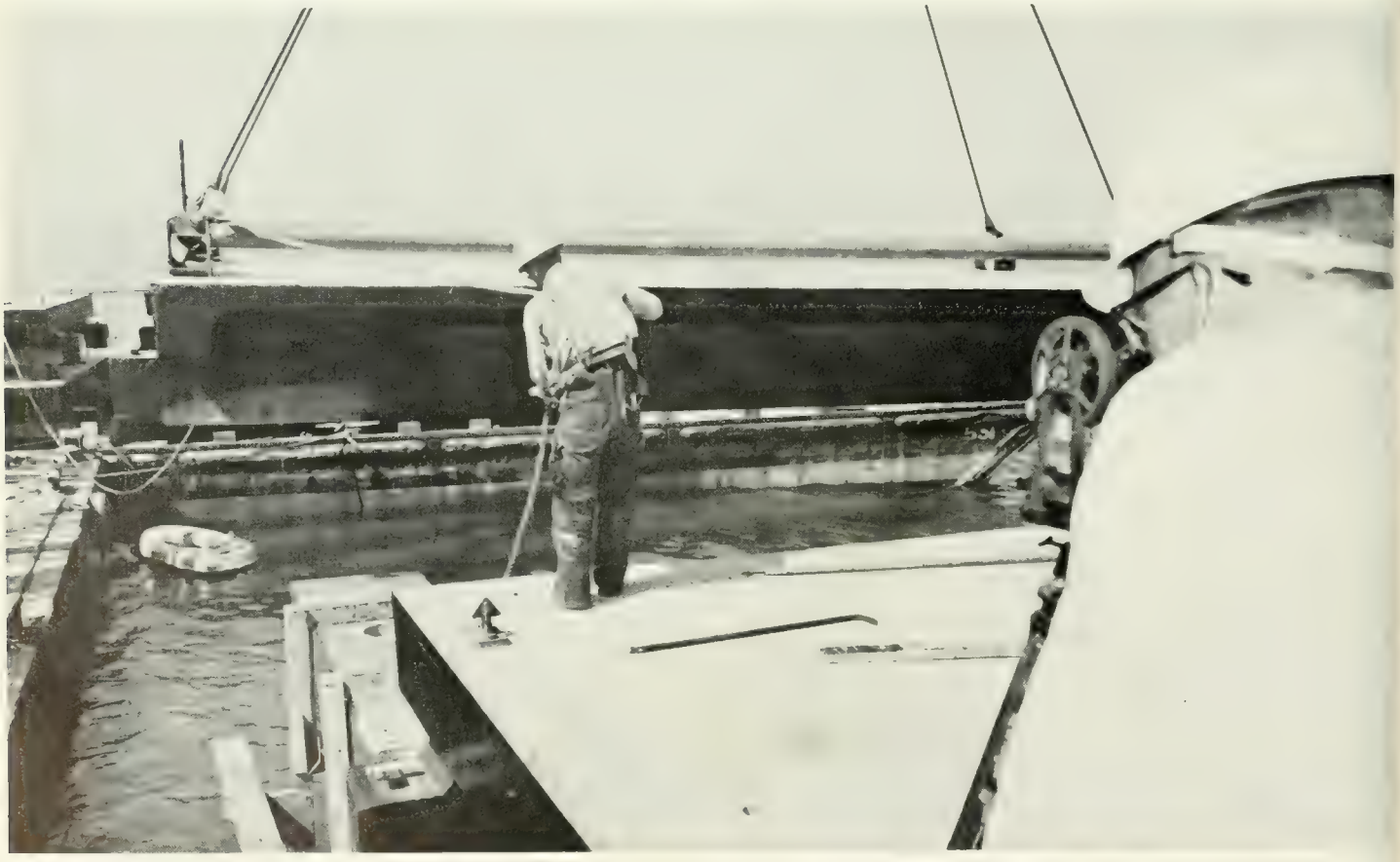
Due to the multiplicity of similar concrete parts, the contractor prepared a casting yard in the City of Richmond for an assembly line production of the different units. This consisted of placing the reinforcing in steel forms, casting, curing, waterproofing, and later barging the units to the site for erection.



Looking east toward Hayward, showing mole fill at east end of bridge project where toll plaza will be built. Note mud displaced by fill. Start of new concrete trestle in foreground.



TRESTLE CONSTRUCTION. Pile driving background followed by pile cutoff setting caps and deck units.



PLACING DECK UNITS. Large cores in deck for placing concrete in top of pile.

The yard, which is one-half mile in length and 250 feet wide, is divided into areas for casting piles, deck units, caps, curb and rail units; it also provides space for the curing and waterproofing prior to shipping.

Straddling the length of the yard are three gantries operating on one set of railroad rails spaced at 70-foot centers. These rail facilities not only handle the completed casting, but transport the materials needed in the construction.

Probably the most interesting and novel yard procedure is the continuous casting of the prestressed, hollow standard concrete piles.

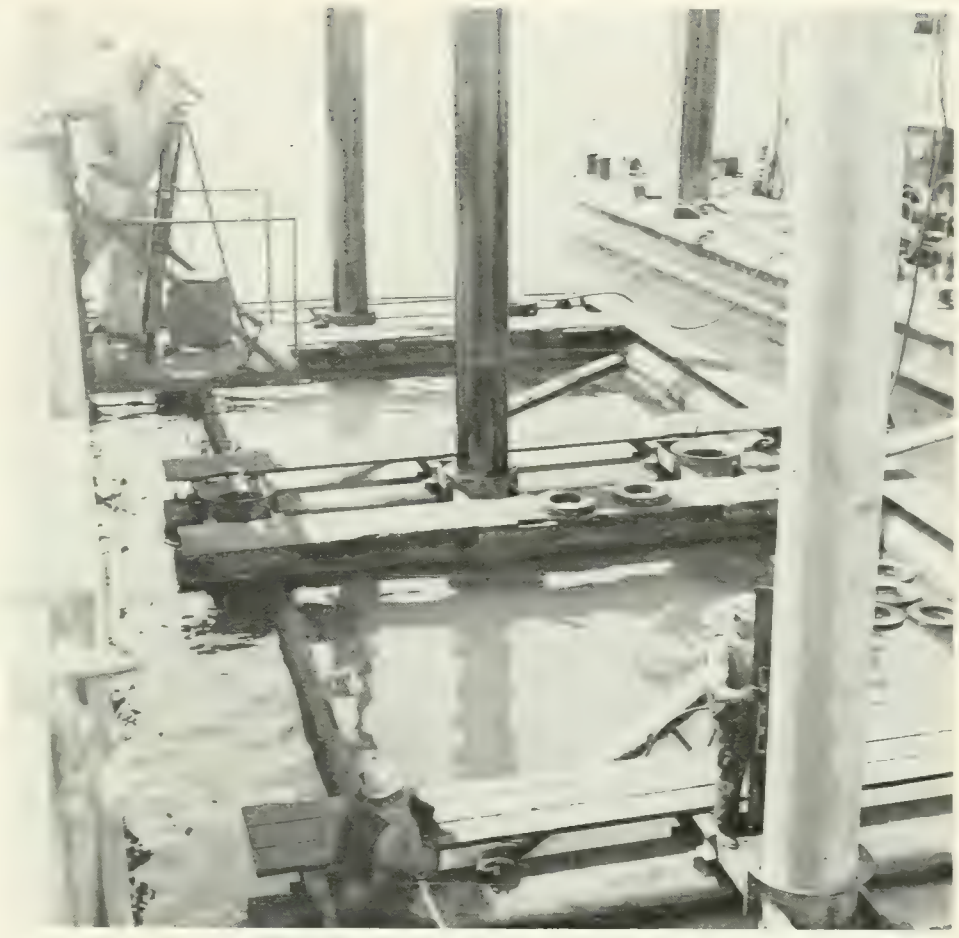
Four individual 900-foot beds were constructed by the contractor, each consisting of a 24-inch diameter, half-circular metal form encased in concrete. Flanges on both sides of top edges served as supporting tracks for the movable, half-circular upper form with material hopper and concrete vibrators attached.

105-foot Mandrel

Partially supported from the lower form by means of movable rollers and traveling independently at the same speed as the upper forms is a 15-inch cylindrical mandrel 105 feet in length which forms the 4½-inch shell thickness. These units are moved at a rate of five to seven feet a minute by a cable reeled in at one end of the casting bed. Circular removable partitions are placed in the form and are set to the length of the pile desired. They are notched to space and retain strands in proper location in pile shell. The speed of the movable forms is slowed to 1½ to two feet a minute at these partitions.

While casting is taking place in one bed, another retains the previously cast piles for curing, and the third bed is being cleaned.

The fourth form is prepared for casting which consists of placing a bundle of No. 5 spiral wire between each pile partition, stretching, 13 7/16-inch high-strength seven-wire steel strands the full length of the bed. They are clamped at one end and stressed at the other which are then positioned and supported by the pile partitions which are used to separate the continuous casting into the proper pile lengths. The spiral hooping is then spaced and tied to the individual strands along the length of the pile.



PILE DRIVING. Center pile of three-pile bent being plumbed in floating template.

Piles Are Heat Cured

After casting, the piles are heat cured by placing a half-circular hood over the upper portion of the form and then admitting steam. The heat is gradually raised and then lowered through a 16-hour thermostatically controlled cycle. After the concrete has reached a strength of 4,000 psi, the stress at the ends of the steel strands is released, the wires are cut at the partitions, the piles are removed from the forms for drying and waterproofing, the forms are cleaned and ready for another cycle.

After casting and curing, the piles are removed by the gantries and placed on skids where the upper portion of the pile, which will project above the mud line after driving, is sandblasted and painted with three coats of waterproofing material. Two protective coats are placed on the pile caps and undersurface of the deck units prior to barging to the site.

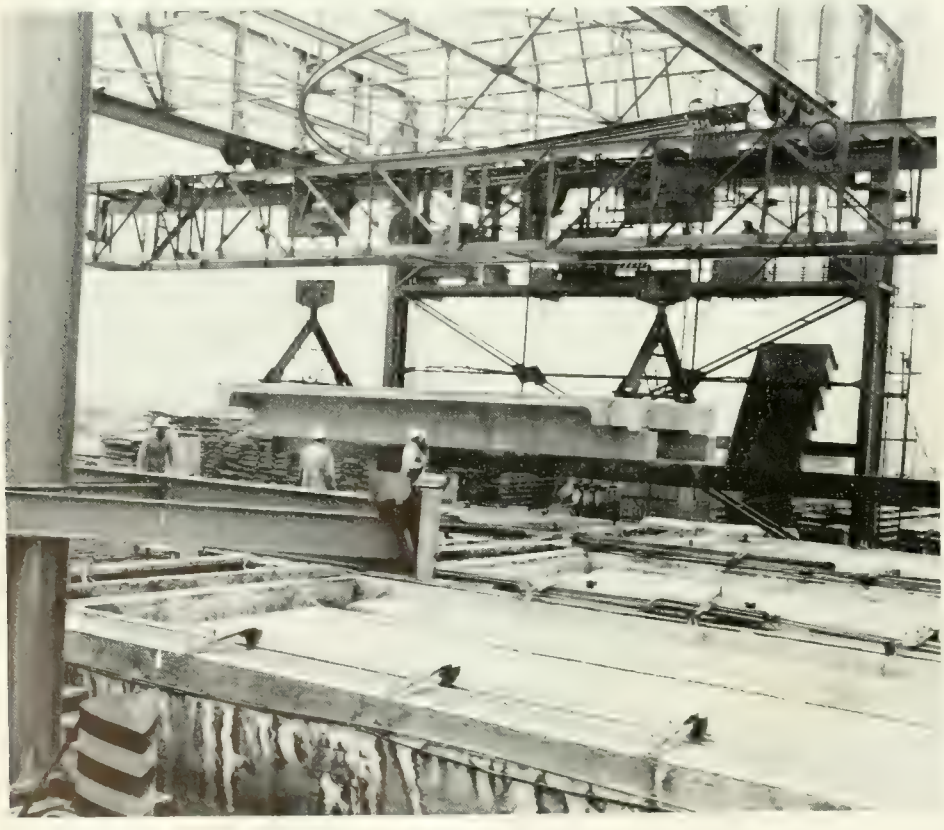
There are 16 steel forms provided for the casting and partial curing of the deck units. Prior to placing concrete, most of the reinforcing steel for the deck unit is assembled, tied together and placed in the forms. The armored roadway expansion joints are accurately set and fixed in the form; also, threaded steel inserts to which the curb and railing section will be bolted and placed at this time. In the event two additional lanes are needed in the future, the curb and rail units can be unbolted and shifted to the widened six-lane roadway. The pile caps also have provisions for their extension.

Dimensions Constantly Checked

Where there is a repetition in the fabrication of standard or duplicate units, checks must be continuously made of the dimensions to which the unit is cast. A slight error in any



PILE CUTOFF OPERATION. *Cutting off and aligning piles prior to placing caps.*



CONCRETE ROADWAY UNITS. *Cast unit being lifted from steel forms shown in foreground.*

length will lead to an accumulated error in the field resulting in either an under or overrun of distance. An error of over two feet occurred during the construction of the original trestle and is now being corrected in the new construction.

The roadway spans are steam cured and after the concrete has reached a strength of 2,400 psi, the units are removed from the forms, first by means of compressed air introduced through fittings on the underside of the form at the center of the slab to break the skin friction of the concrete on the steel faces, and secondly by the gantry's sling and strongback which transport the units to another area of the yard for air curing and waterproofing.

The pile caps, as well as the curb and rail sections, are cast in steel forms and handled in somewhat the same manner as the deck sections.

Three conduits are placed in each curb to provide for the main and secondary power lines and three additional conduits are placed in the railing for lighting, telephone and supervisory control wires.

Erection Procedure

Funds for the construction of the new San Mateo-Hayward Bridge are derived from the net revenues of this crossing combined with those of the San Francisco-Oakland Bay and Dumbarton Bridges.

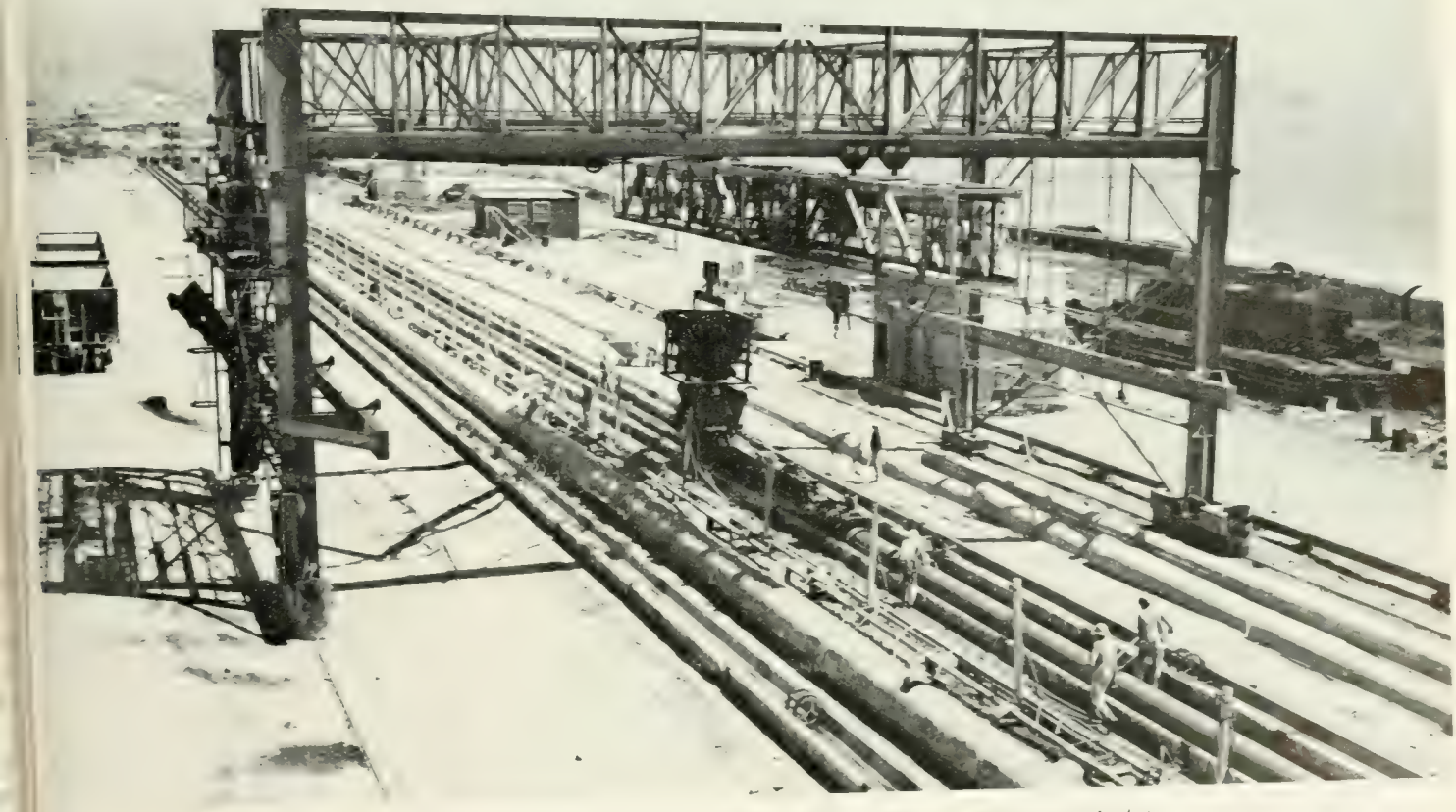
The plans call for the contractor to maintain two lanes of traffic, one in each direction, for the uninterrupted flow of vehicles. The contract also requires the new trestle be constructed contiguous to the old viaduct for detouring from one roadway to the other and for the providing of working space for the contractor's men and equipment.

Both the preliminary and final studies not only considered the methods and materials to be used in the construction but the production, furnishing, and placing of the various parts; also the salvaging and reuse of any units in the future due to expansion or damage to the structure.

A ruling of the U.S. Engineers required the removal of all material from the site, which included the railing,



CONCRETE PILE CURING showing cover for initial heat curing.



PILE-CASTING OPERATION showing top movable form being filled from bottom dump bucket.

deck units, caps, and piling of the old concrete viaduct.

After examining and taking core samples of the original piles, it was considered doubtful that they could be extracted without breaking at the waterline due to the small amount of steel reinforcing in the pile and the amount remaining after deterioration.

Pile Removal Costly

It was estimated that the cost of removing these old piles, which was later verified by the contract unit prices, would be greater than the driving of new piles.

Construction of the new north two-lane roadway required the following major operations:

Striping the present 27-foot roadway for two 12-foot lanes.
Erecting a barricade along the north lane.
Removing rail and curb of existing trestle.
Placing and centering twelve 24-inch piles in a jig.
Driving piles for north bents.
Cutting off pile ends to grade.
Placing and concreting pile cap to grade.
Placing two roadway units.
Leveling and dowelling units to cap.
Erecting curb and rail units on north side.
Striping new roadway.

The 27-foot wide roadway of the old trestle was restriped for two 12-foot lanes. A temporary timber curb with steel skid beam was erected along the north lane which provided working space for the contractor while dismantling the old concrete curb and rail.

Precast Piles

The driving of the precast piles was the controlling field operation and generally preceded all others.

The length of piles for the individual bents were ordered in advance by the engineer for casting and barging to the site as needed.

Payment for the piles in place was made on a lineal foot basis and a unit amount for the driving of each. The application of the waterproofing to the piles and other units and any repairs to the same same are included in the contract price.

To minimize the length of pile cut off after driving, extensive foundation exploration borings were made and this information was compared with the boring logs of the old structure and those obtained for a powerline which parallels the bridge. These in turn were compared with the length of piles that had been driven in the previous construction.

The piles are lifted from the barge by a Whirley type floating derrick of 75-ton capacity and placed vertically in a floating jog which accommodates 12 piles. The piles are plumbed and driven until a minimum capacity of 60 tons had been obtained. After driving, the template is separated and floated forward and accurately spaced for the setting of the piles in the next three bents.

The hammer is a double-acting steam hammer fitted with a special driving head modified by the contractor to minimize the breaking and splitting of the tops of the concrete piles.

Carborundum Saws Used

Circular carborundum saws were used to cut the piles to grade prior to the placing of the precast concrete caps. All piles cut off, as well as the curb and railing removed from the old structure, were placed on a barge and the debris was deposited in spoil areas obtained by the contractor.

Following the cutting off of the pile to grade, a collar devised by the contractor is bolted to their tops which provides for the bolting of an adjustable strut between the piles to obtain the nine-foot transverse spacing.

The three pile tops are brought into longitudinal alignment by the weight of the precast cap when lowered into the battered spacing plates on the collars.

The tops of the piles fit into a two-foot-two-inch diameter hole in the bottom of the cap. This circular opening is 2½ inches deep and is connected by another 15-inch hole with the top of the cap.

The cap was permanently attached to the upper part of the pile by lowering a circular cage of reinforcing steel three feet six inches into the pile; the upper two feet three inch length remaining in the cap. A 15-inch circular wooden plug was wired to the lower end of the steel to retain the concrete which filled the upper portion of the hollow pile and the circular hole in the cap. The concrete was poured through precast circular openings in the slab after the roadway units were placed and leveled.

The deck units are 14 feet 7 inches in width and 29 feet 11½ inches in length. Four units provide two 13-foot curb lanes, two 12-foot lanes, and a median strip of four feet.

Provision for More Lanes

If an increase in traffic requires additional bridge width, two additional units can be erected on the north side to provide two 13-foot curb lanes, four 12-foot traffic lanes, and a median strip of nine feet two inches.

The trestle consisted of a series of 30-foot simple spans of lightweight concrete, one end of which rests upon and is firmly anchored to the top of the concrete cap. The other end rests on a short cantilevered length of the preceding span by a metal shoe.

In the early planning stages this 30-foot span was compared with the cost of a 60-foot prestressed standard concrete design and a sand fill.

Records have shown that highway fills constructed upon the soft materials underlying the waters of San Francisco Bay are not stable and have required extensive roadway repairs. The settlement, the record of which is previously mentioned, for the fill on which the toll plaza is to be located is typical of other fills placed by the department. The initial cost of a fill with the amount of maintenance required over a 25-year period was not economically justified and consequently this plan was not adopted.

Another study using 60-foot prestressed concrete spans was considered and rejected due to cost resulting from the following:

Four piles in every other bent of the old trestle would have to be removed.
The ejection of the old piles would have increased the cost by $1,600,000.
The cost estimates for overwater construction indicated no savings for the longer precast, prestressed spans.
Larger floating handling equipment would have required a greater amount of channel excavation on each side of the new construction, thereby increasing cost.

The study for a 30-foot span revealed many savings, particularly when lightweight concrete was considered for the construction of the

roadway units, together with curb and railing sections.

Overall Cost Decrease

The lightweight aggregate and extra cement required increased the concrete cost by $4.50 per cubic yard; however, the lighter load imposed upon the piles eliminated one pile per bent which gave an overall decreased cost of over $300,000. By so planning, the four piles in the original trestle did not have to be removed, as the three new piles were spaced to miss the old and were placed in the same plane.

When taking into consideration the rough water encountered in the erection, the amount of protective coating required, and the isolation of the site, the cost of $9.50 per square foot of roadway surface compares favorably with other trestles constructed under similar conditions.

Cast in "L" Shape

The rail and curb is cast in an "L"-shaped form which contains three two-inch conduits in the rail for primary and secondary roadway lighting electrical wires and three in the curb for the primary bridge electrical circuit.

The curb is 10 inches above the surface of the roadway and has a seven-inch face. The remaining three inches was left open for deck drainage. The rail and curb units are 29 feet 11½ inches in length, the same as the slab and are supported by five 18-inch x 24½-inch blocks through which two one-inch stud bolds are fastened into the deck inserts. This section can be moved intact if the roadway is widened for additional traffic lanes.

There is also cast into each wall a metal pullbox which will also house the ballast for the roadway lighting. The curb has a pullbox every 300 feet.

Inserts were aslo placed in the top of the wall to which will be fastened the brackets supporting a five-inch-diameter metal safety rail to be furnished under another contract. Additional inserts were provided in the wall of each span for roadway lighting, signs, and signals where needed; also, for the roadside emergency telephone boxes.

No Explosive Used

The breaking out of the old concrete structure proved to be a very slow and expensive operation as no explosive could be used in the demolition and all debris had to be moved from the site.

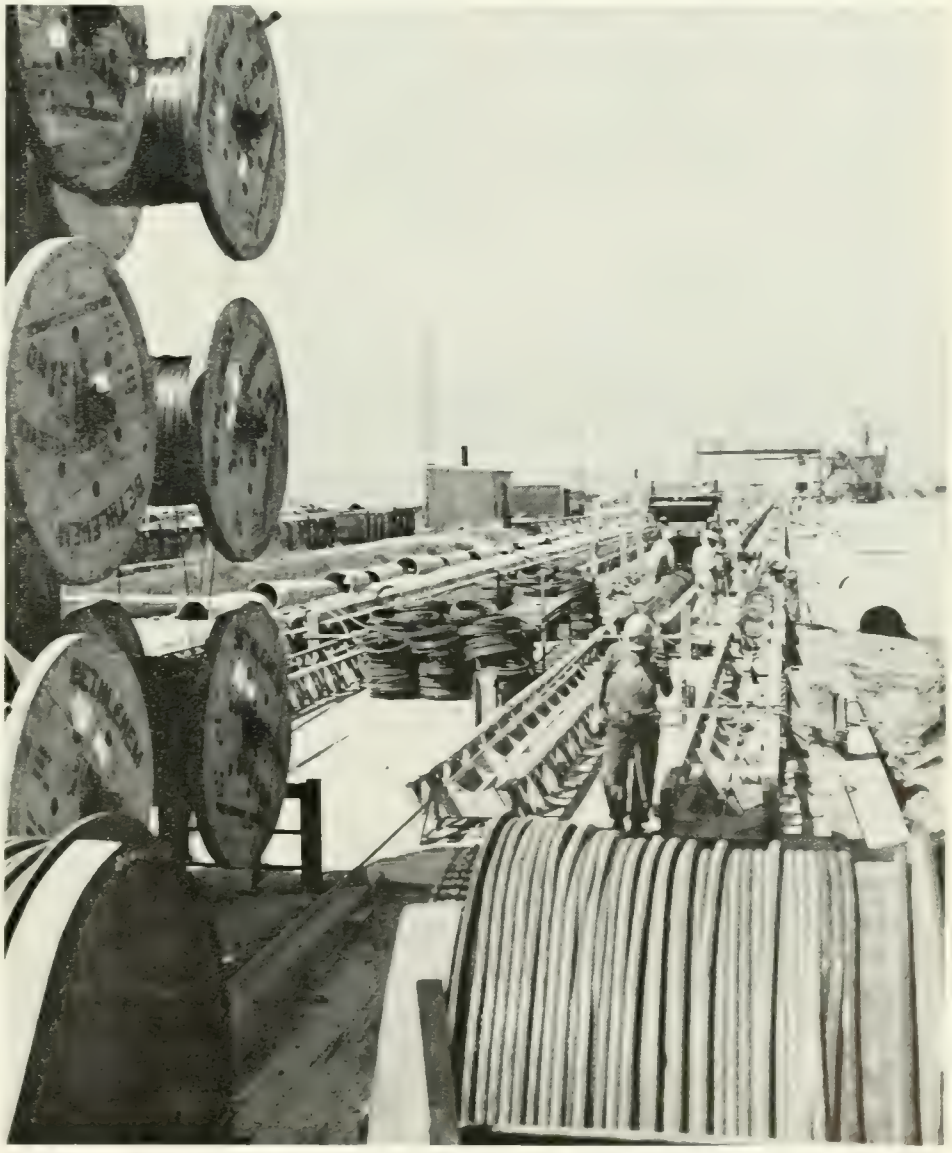
The contractor employed an air-operated hammer that was set vertically in a steel frame stand which was moved about on the bridge deck. Fitted into the hammer was a large steel spud which cracked the slab and girders at each bent. The assembly was moved by a truck crane ahead of the work.

The old concrete units together with the other broken parts were dropped onto the deck of a barge cushioned with old rubber tire casings to break the fall.

The tops of the four piles in the old bents were cut off just below the cap and these were deposited in the bay with the rest of the debris in certain designated areas.

The shimming of the roadway units to exact elevation has produced a level riding surface which should not require an aspalt topping for some time in the future. The open curbs provide a clean deck and good drainage.

(Additional articles will follow on the high-level steel crossing of the navigation channel and other features required by toll bridges.)



PILE-CASTING YARD showing stressing and hauling equipment.

Sierra County Supervisors Express Thanks

SIERRA COUNTY
BOARD OF SUPERVISORS

RESOLUTION NO. 958

WHEREAS, Sierra County has recently suffered the most severe flood and storm damage to its roads and bridges in many years; and

WHEREAS, Traffic over State Sign Route 49 leading south and west from Downieville, the county seat, was completely halted for some time due to the loss of the bridge at Indian Valley over the North Fork of the Yuba River; and

WHEREAS, Traffic over the same State Sign Route 49 leading north and east from said county seat was also halted, due to road damage between Downieville and Sierra City; and

WHEREAS, State Sign Route 49 is the only main access into and out of said county seat, and said area was therefore isolated from the outside during said period; and

WHEREAS, The State Division of Highways, through Mr. J. C. Womack, State Highway Engineer, and Mr. Alan S. Hart of the Division III office in Marysville, and through their local representatives Mr. John L. Snider, maintenance superintendent, and Mr. Donald A. Kipp, highway foreman, all combined to go out of their way to an extent this board feels was "far and beyond their ordinary duties" in seeing that said bridge was reconstructed, and said highway damage repaired, in a remarkably short period of time, thus assuring prompt resumption of transportation to said stricken area; and

WHEREAS, The McNamara Construction Company, Ltd., Bayshore Highway, Burlingame, California, currently engaged in private road construction in the Sierra County area, made available its equipment and manpower on an all-out day-and-night basis to assist in reopening said highway between Downieville and Sierra City.

Now therefore be it hereby resolved: That this board does publicly thank each and all of the above-named departments and individuals for their generous emergency co-operation and assistance, and the clerk is hereby directed to notify Governor Edmund G. Brown of said facts, by transmitting to his office a certified copy of the within Resolution, and to also mail forthwith additional certified copies to the following:

1. Mr. J. C. Womack, State Highway Engineer
   Sacramento, California
2. Mr. Alan S. Hart, District Engineer
   Marysville, California
3. Mr. John L. Snider, Maintenance Superintendent
   Nevada City, California
4. Mr. Donald A. Kipp, Highway Foreman
   Downieville, California
5. McNamara Construction Company, Ltd.
   Bayshore Highway
   Burlingame, California

The foregoing resolution was duly passed and adopted at a regular meeting of the Board of Supervisors of Sierra County, California, held on the 18th day of February, 1963.

ATTEST:
FLORENCE B. McCORMICK
Clerk of said Board

DON G. PATTON
Chairman, Board of Supervisors,
Sierra County, California

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

February 27, 1963

Board of Supervisors
Sierra County
Downieville, California

GENTLEMEN: Your resolution of February 18, 1962, regarding the reopening of Highway 49 in Sierra County following the recent record storm is certainly appreciated.

I do feel that an outstanding job was done in the emergency restoration by Division of Highways personnel and the construction industry people involved. However, this could not have been accomplished as speedily as it was without the full co-operation extended by local officials and residents.

The self-reliance of the people of the area and their recognition of the magnitude of the task was most helpful in the disruptive situation.

From a personal inspection on February 17 I know that we face a major and urgent job of permanent restoration. The division staff is now engaged in the planning necessary to fully restore two-lane operation, with appropriate protection against future floods.

Sincerely,

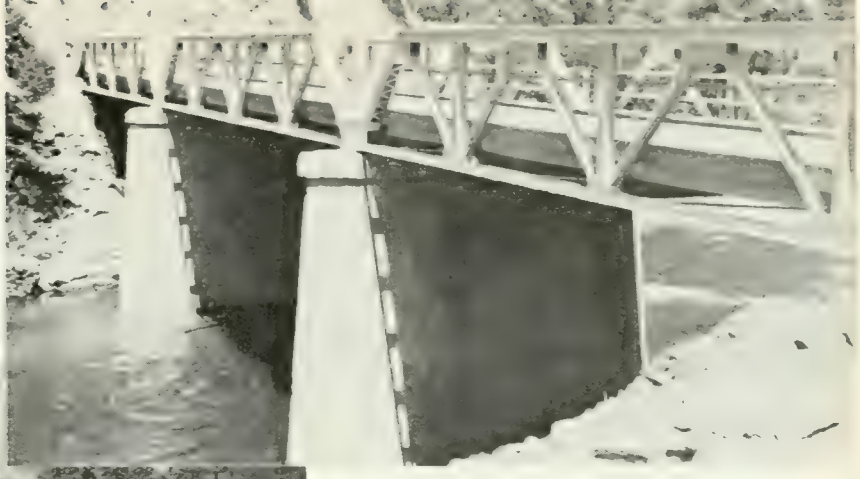
J. C. WOMACK
State Highway Engineer

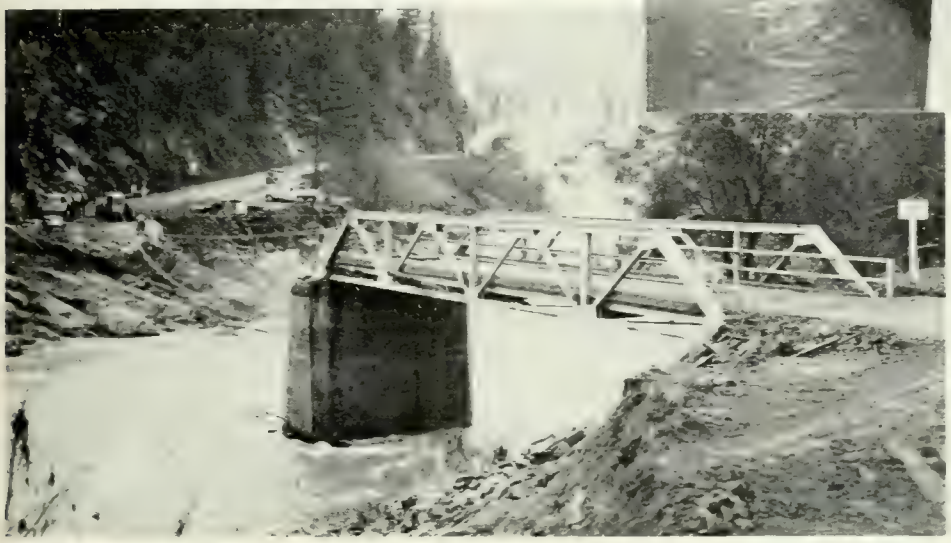
Cut Cable Closes Rio Vista Bridge

Dredging operations in the Sacramento River at the Rio Vista Bridge cut the underwater power cable for the bridge's lift span the night of December 18. Traffic on State Sign Route 12 which traverses the bridge was diverted to the Steamboat Slough and Cache Slough ferries until the morning of December 21 when temporary repairs were made. Considerable traffic delay continued until the drawbridge resumed normal operations the afternoon of December 24.

Sierra Rains

Washed Out Bridges And—





In the sudden torrents released by the rains at January's end, a few Sierra bridges were casualties. The Yuba River Bridge on State Highway 49 about 14 miles west of Downieville was one, illustrated with "before and after" photos above. Note that two spans and a pier were carried away. The two spans have been replaced by a 120-foot steel girder single span. Sulphur Creek (below) was repaired by jacking bridge and abutment back into place, refilling approach.



Abutment of bridge at Riverton on U.S. 50 which "almost went." At Sulphur Creek on S.S.R. 89, center right, stream not only tore out fill at abutment, but also undercut abutment.



Below. Bridge over Spanish Creek on U.S. Highway 40 Alternate, just north of Quincy, Plumas County, where stream undercut pilings sunk 10 feet below the streambed. Temporary repairs have been made; two spans will be replaced in spring.



Undercuts and Slipouts;





Routes through canyons in both the Coast Range and the Sierra suffered severe damage when rampant waters cut away adjacent highways. Above is State Sign Route 128 after it was torn up by normally small and peaceful Conn Creek near St. Helena in Napa County. Below is a single sample of the effect of widespread undercutting on State Sign Route 49 along the middle fork of the Yuba in the Downieville vicinity.

Above: Slipout on eastbound lanes, U.S. 40/Interstate 80 at Whitmore Maintenance Station, at about 5,000 feet altitude. Blue Canyon, a few miles east, recorded 16 inches of rain in 3 days. Below: Waters of Yuba River south fork near Cisco here partly receded after having savagely torn out several hundred yards of paving, subpaving, and fill on U.S. 40.





Slides, Mud, Debris, and Plugged Drains.







Waterborne debris plugged drains and cluttered road surfaces; saturated cut slopes slumped to the paving to keep weary maintenance crews working on a round-the-clock operation. In a few days most routes were open on a "subject to delay" basis; within two weeks traffic generally was normal.







U.S. 60 Freeway

Traffic Flows Over New 5½-mile Riverside Section

By TAYLOR SMITH, Resident Engineer



The first unit of the relocation of U.S. Highway 60 skirting the City of Riverside was completed in 1961, and the second and final unit was completed in January, 1963. The first 2½-mile section stated at Orange Street in Riverside and extended southeasterly to the existing four-lane section of Highway 60 near the University of California at the east city limits. Completion of the second section, 5.6 miles in length, between Sunnyslope and Orange Street greatly reduces traffic congestion on two of the city's principal east-west streets which previously served as the highway.

The route for this freeway was adopted early by the California Highway Commission in July 1954, primarily to assist city planners. It is interesting to note that the engineering for this project was sufficiently advanced so that the district was able to purchase property necessary for the freeway whenever a property owner desired to sell.

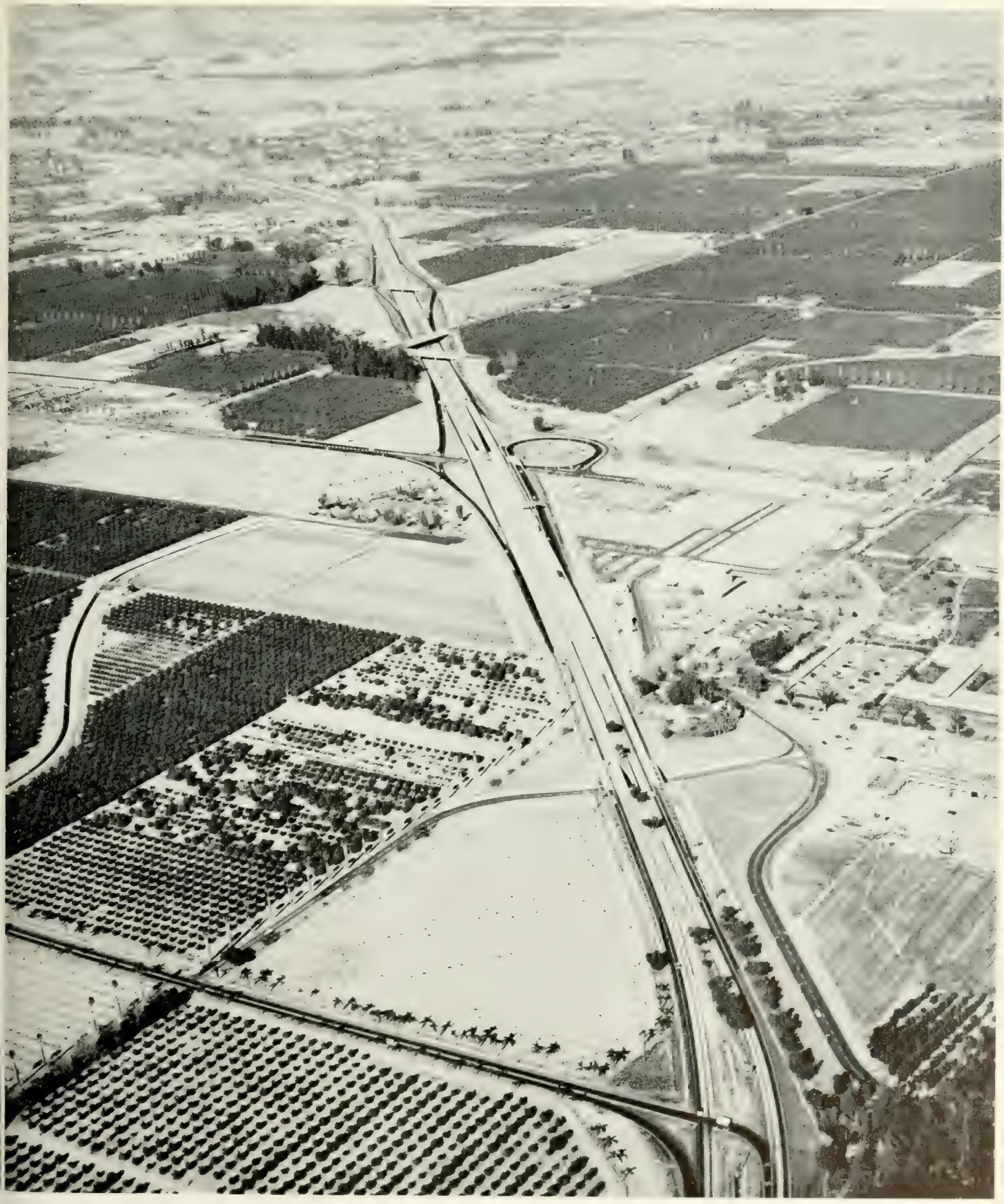
Enough Land Acquired

The new freeway is a four-lane divided highway with a 46-foot median. Sufficient land has been acquired for widening to six lanes with a 22-foot median when necessary. The through traffic lanes are of portland cement concrete over cement-treated base. Three overhead structures carry the roadway over the Union Pacific Railroad at Sunnyslope, the Atchison, Topeka & Santa Fe Railroad at Down Street, and the Southern Pacific Railroad at Chicago Avenue. A reinforced concrete bridge 1,054 feet long spans the Santa Ana River. A full cloverleaf separation was constructed at the junction of U.S. Highway 60 and U.S. Highway 91. Spaced throughout the two projects, 12 structures are provided for cross traffic on local city streets.

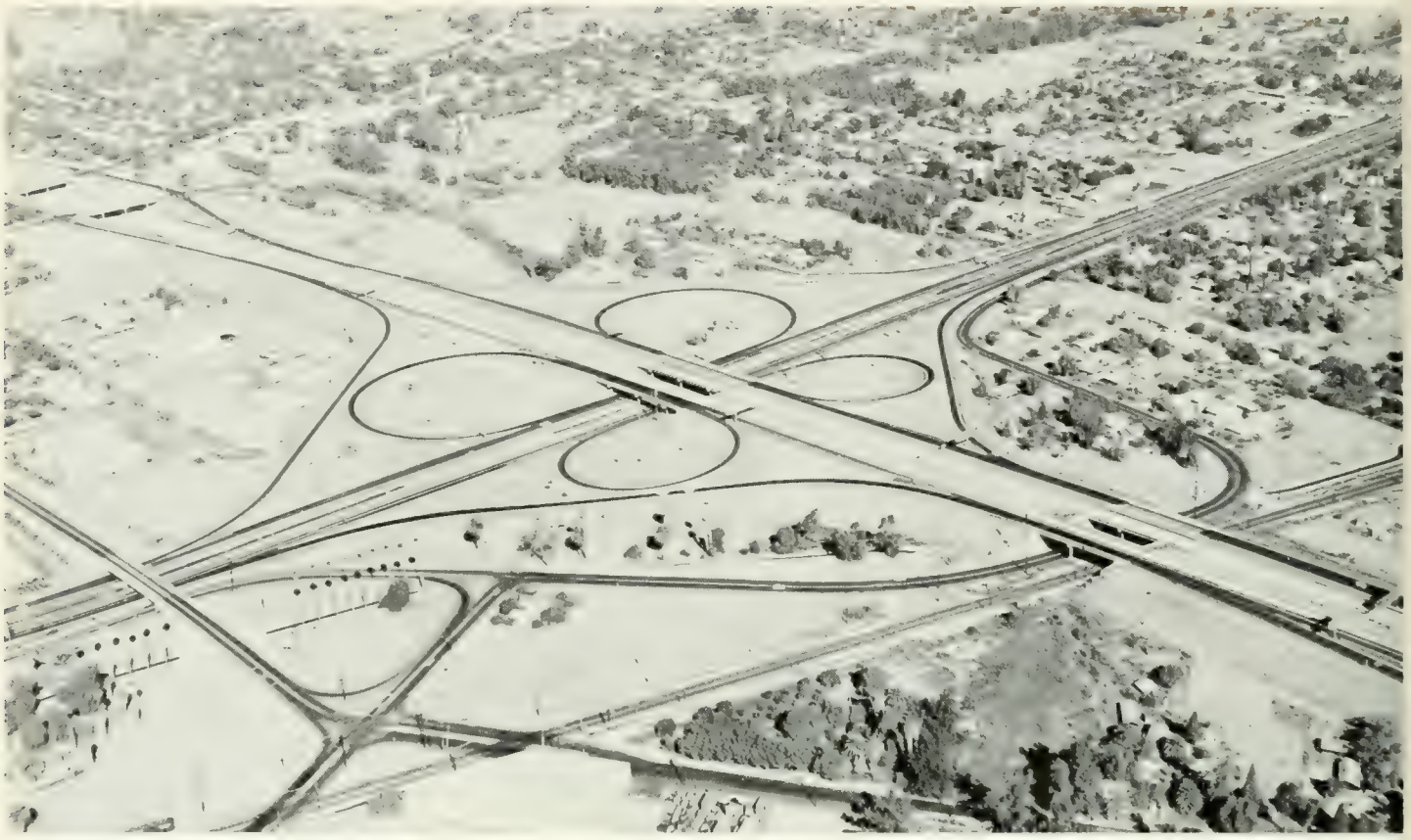
Portions of the embankments for the relocation were constructed with excess material from adjacent projects prior to the final contracts. In 1957, 325,000 tons of excess material from channel widening of the Santa Ana River was placed in the roadway prism. In 1959, 412,000 tons of excess excavation from construction of the north-south Riverside Freeway and 116,000 tons of excavation from interim construction of railway separation structures on the existing route of U.S. 60 in Riverside were placed in the embankments of the relocation. An additional 793,000 tons of imported borrow were placed under the two final contracts.

Looking west along the new alignment of U.S. 60 with the north-south Riverside Freeway in the foreground and the Santa Ana River in the background. Palm trees have been transplanted in the interchange area.





Looking northwest along the new alignment of U.S. Highway 60 from the University of California (right foreground) at the east city limits of Riverside, showing the Eighth Street Undercrossing, Linden Street, Iowa Avenue, and Blaine Street Overcrossings.



The U.S. Highway 60/395 Interchange with the Main Street and Orange Street Overcrossings at the extreme left and the Down Street Overhead at the right. Many of the transplanted palm trees are visible in the contour-graded areas.

Conventional Equipment

Conventional paving equipment placing 12-foot lanes with steel headers was used to place the concrete pavement on the completed unit between Orange Street and the university.

Lewis slip-form paving equipment was used for placing both cement-treated subgrade and concrete pavement on the second unit. The concrete pavement was placed in two-lane widths. A recent addition to the paving machine was a mechanism for placing a continuous polyethylene plastic paper in lieu of sawing the longitudinal joint between traffic lanes. Excellent results were obtained with the device which was occasionally referred to as the "outboard motor which pushes the paving machine."

The existing highway, relinquished to the city following completion of the relocation, has been improved by other interim projects in recent years. The old Mission Bridge across the Santa Ana River, was replaced with a new structure in 1958. The work was performed by the Division of Highways acting as agent for the Riverside Flood Control District, concurrent with Santa Ana River control work by the U.S. Army Engineers. In 1959, three underpasses and two railway separations were constructed on Eighth Street east of the Riverside Freeway. All of the city streets serving as the highway were resurfaced prior to relinquishment.

Travel Time Savings

The 7.8-mile relocation does not provide a savings in distance for through east-west traffic, but does effect a 10-minute savings in travel time by eliminating 15 traffic signals. It is estimated that the annual savings in time alone for through traffic will exceed $350,000.

An unusual request to modify the planned drainage system west of Bloomington Boulevard, so as to intercept and divert a portion of upstream drainage and dispose of it through a modified median storm drain, was received from the Riverside County Flood Control and Water Conservation District after construction had started on the project between Sunnyslope and Orange Street.

Although the project plans provided for construction of an 8-foot x 5-foot reinforced concrete box culvert to carry upstream drainage across the right-of-way without altering the existing drainage pattern, winter rains during the past season caused a great deal of apprehension among property owners downstream from the right-of-way.

Riverside County officials, recognizing that remedial action was necessary, faced the problem of either constructing a drainage system to take the water underground from the outlet of the culvert southerly through the suburb of Rubidoux to the Santa Ana River or having the Division of Highways modify its planned drainage system so as to divert the water to the Santa Ana River within the State's right-of-way. Inasmuch as the latter would eliminate costly utility reloca-

tions, would not disrupt local traffic, and would be less expensive, the county flood control district requested that the Division of Highways modify its planned drainage system by enlarging and extending the original design so as to intercept up to 85 cubic feet per second of storm runoff at the inlet of the planned culvert crossing the right-of-way.

County Does Design Work

Through the co-operation of county and state officials, agreement was reached whereby the county performed the necessary design work and bore the increased cost of the system. The work was performed by the contractor, the Winston-Green Company, concurrently with his other operations. County officials estimated that a savings of $50,000 to the county was realized by eliminating the need for the underground system downstream from the right-of-way.

Although the section of roadway between Orange Street and the university was officially opened to public traffic on October 25, 1961, with appropriate ribbon-cutting ceremonies attended by state and local dignitaries, westbound traffic had a preview of the new freeway two weeks earlier. The International Raceway, located east of the City of Riverside, conducts the Grand Prize Sportscar Race each October. The race annually attracts an estimated 75,000 racing enthusiasts, whose exodus in 20,000 vehicles following the race has in the past caused monster traffic snarls.

In an attempt to alleviate the traffic congestion following the race, Riverside officials and the California Highway Patrol petitioned the contractor and the Division of Highways to open the westbound lanes of the freeway following the race to permit Los Angeles-bound traffic to reach the north-south Riverside Freeway without using the existing highway through the city. Although all surfacing had been completed on the westbound lanes, work on illuminated signs, roadside signs, guardrail, guideposts, etc., was still in progress.

Through the excellent co-operation of the contractor and city and state forces, temporary direction signing was erected and mobile generators provided to illuminate incomplete sign structures. The westbound traffic lanes between the university and the separation at the Riverside Freeway were opened at 3 p.m. and closed at 7 p.m. on October 16. Although an estimated 20,000 vehicles used the westbound lanes in the four-hour period, only one minor rear-end collision occurred and no damage was inflicted on the highway facilities. In previous years, with traffic on the old highway, the Riverside Police Department required 24 officers to direct and control traffic; while with traffic on the freeway, only 7 officers were required. All agencies concerned in the temporary opening of the roadway received many favorable comments.

The E. L. Yeager Company, E. L. Yeager Construction Company, Incorporated, and J. B. Stringfellow were the contractors on the completed $3,875,000 unit, with Resident Engineer Taylor Smith representing the State.

The contractor on the $4,860,000 unit recently completed is the Winston Brothers Company and Green Construction Company, with K. B. Stone, Resident Engineer for the State. D. B. Jennings acted as Bridge Department representative on both contracts.



The mechanism mounted on the slip-form concrete paving equipment places a continuous polyethylene plastic paper joint between traffic lanes.

BPR Announces New U.S. Road Totals

Roads and streets in the United States, under the jurisdiction of all levels of government, totaled nearly 3.6 million miles in 1961.

The data, compiled by the U.S. Bureau of Public Roads from information supplied by the states, show that rural roads comprise slightly over 3.1 million miles of the United States total; municipal roads 446,000 miles.

Some 985,000 miles of all roads and streets in the United States are unsurfaced. Of the surfaced mileage, 1.3 million miles are soil-surfaced or have surfaces of gravel, crushed stone, or slag. Nearly 1.3 million miles have surfaces ranging from bituminous surface treatment to bituminous and portland cement concrete.

The road and street systems in the United States have grown but little in extent, proportionately, in recent years. The nation's needs lie generally not in more mileage but in improvement or replacement of existing highways. As one indication of improvement progress, the mileage of unsurfaced roads and streets has been declining at an average rate of 3 percent during recent years.

Pixley-Tulare

13-mile Section on U.S. 99 Converted to Full Freeway

By K. P. OLIPHANT, Assistant Highway Engineer



Freeway conversion of 13 miles of U.S. 99 in Tulare County between Pixley and Tulare Airport was completed in November.

This project, beginning in May 1961, involved the construction of five interchanges, reconstruction of one mile of the east and west lanes near Quail and reconstruction of the west lanes from Tipton to the Tulare Airport. The construction cost was $3,400,000. Griffith Company was the contractor.

One of the most critical phases of this project was the construction, signing, and striping of detours to route motorists safely through the area. Detouring high-speed traffic on any road is a serious problem. Traffic on U.S. 99 through this part of the southern San Joaquin Valley is not only high speed, it is also relatively high in volume, averaging 14,000 cars

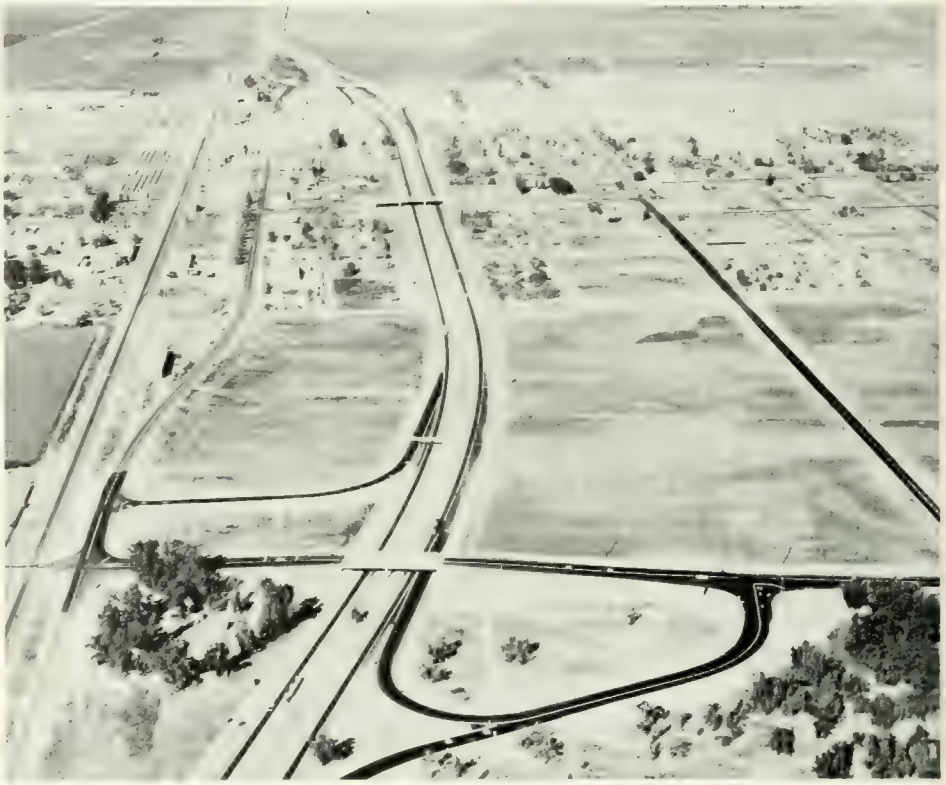


PHOTO ABOVE. Sign Route 190 intersecting U.S. 99 Freeway in foreground. Community of Tipton in upper part of photo. BELOW. This photo shows oversize signs cautioning motorists of "detour ahead."



per day. In order to provide for maximum possible safety for the traveling public, a great deal of planning, many new ideas, and strict traffic controls were incorporated into the detours.

Some 4-lane Detours

Plans called for two-lane detours of a four-mile section between the Tule River and the Tulare Airport, and for four-lane detours from Tipton to the Tule River and a section near Quail. The two-lane detour was, of course, the most critical from traffic safety standpoint. Accordingly, the construction time schedule for this section was under very strict control, specifying only 82 working days for the completion of the west lanes, to be constructed in two separate parts. The first part was to be completed and opened to traffic prior to starting work on the second part. The contractor's forces performed very efficiently during this phase, completing the west lanes in only 71 working days.

With the knowledge that the motorist had driven many miles of full freeways, both north and south, of this project without the necessity for changing speed or making abrupt changes in alignment, we were confronted with the problem of providing the traveling public with the maximum advance information that the situation ahead was going to be different. Therefore, a number of oversize signs were installed. Many of these were made on plywood and were four feet by eight feet, and six feet by eight feet in size. Some of these warning signs were supplemented with flashing lights to further call attention of the approaching change.

Asphalt Blanket Placed

In the past, considerable difficulty had been encountered at the beginning of detours were traffic was forced to leave the concrete lanes and turn onto a blacktop detour. In order to reduce this problem to a minimum and to provide the motorist with the most adequate and visible turnoff to the detours, an asphalt concrete blanket was placed over the concrete pavement from the point where the detour centerline first deviated from the existing concrete pavement centerline.



This photo shows temporary "no passing" pad down the center of the roadway.



Channelized intersection delineation on asphalt concrete overlay.



U.S. 99 freeway looking north to intersection of Sign Route 190.

Additional delineation of the detour turnoffs was provided for by the installation of six-inch asphalt concrete dikes, with alternate sections painted white, along the outside edges of the detour curves. The turnoffs were further delineated by placing guide posts in paint buckets, behind the dikes. On the second-phase detours, paint buckets with reflective tape on the buckets were found to be more effective than guideposts.

Less Confusion

It was found that the above-described turnoffs worked more efficiently and with far less confusion to the traveling public than turnoffs where no overlay was used and where the turnoff was delineated by using large yellow barricades, reflectorized arrows and nine-unit reflectors.

The county road intersections were included in the phase I two-way detour. Channelization at these intersections was developed by widening one of the shoulders to provide sufficient width for left turn storage lanes. This was accomplished by overlaying the concrete pavement and painting the islands.

The project plans provided that no passing was to be permitted on any section of two-lane detour. An innovation used on this project, which worked extremely well, was a one-inch by two-foot asphalt concrete pad placed down the centerline of the east lanes for the primary purpose of painting a temporary "no passing" stripe. Next to increased traffic safety, one justification for the installation of this pad was to decrease the cost of and speed up the operation of stripe removal when it was no longer needed.

Stripe More Visible

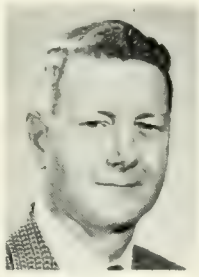
Observation of traffic and inspection of the detours under all conditions indicated that the pad was extremely valuable. Since not only did it make the "no passing" stripe more visible, it also served as a deterrent to crossing the centerline. Very little violation of the "no passing" stripe was observed on the detours on this project.

The contractor and the California Highway Patrol contributed much to the effective operation of these detours. California Highway Patrolmen who drove the detours under all conditions were especially helpful with suggestions for improving their efficiency and safety. The detours were also driven regularly at night by some of the State's engineering personnel. These inspections frequently resulted in minor revisions to improve the detours.

We believe the innovations used in the design of these detours contributed significantly to the safe travel of motorists through the construction project.

HILL, DEFFEBACH, WEBB ARE NAMED TO NEW POSTS

Appointment of George A. Hill as traffic engineer for the Division of Highways and promotion of Richard E. Deffebach to succeed Hill as district engineer—planning, for the Los Angeles district has been announced by State Highway Engineer J. C. Womack.



GEORGE HILL

Hill succeeds George M. Webb as head of the division's traffic department.

Webb, a 34-year employee of the Division of Highways, has been assigned to the newly established position of traffic engineer — special studies, with responsibility for special research projects in the field of traffic as related to route planning.

Deffebach, the new district engineer, will be responsible for route studies, advance planning and programs and budgets for the state highway system in District VII, comprising Los Angeles, Orange and Ventura Counties. For the past four years he has been an assistant district engineer.

Joined Division in 1936

Deffebach was born and raised in Los Angeles and attended Los Angeles City College. He worked for the Division of Highways between 1936 and 1938, and then worked in manufacturing in Los Angeles. He returned to highway work in Southern California in 1940, and served with the Seabees in World War II, in the Pacific Theater and at the training center at Pleasanton.

In November 1945, Deffebach returned to District VII as an assistant highway engineer on construction projects. He became design engineer in 1953 and in 1958 was promoted to assistant district engineer.



RICHARD DEFFEBACH

Deffebach and his wife, Mildred, have two daughters, Nancy and Judy.

Hill, whom Deffebach is succeeding as district engineer—planning, has held that post since January 1960. He is a native of Oakland, and received his civil engineering degree from the University of California at Berkeley in 1937. He joined the Division of Highways the same year and served most of the next nine years in District VI (Fresno), except for World War II military duty with the Army Engineers in Alaska and the Pacific.

Studied at Yale

In 1946 Hill went to Yale University for a year's graduate study in traffic engineering. On his return he was assigned to District IV (San Francisco), and served there until 1953 in construction, traffic analysis and planning functions. In 1953 he was assigned to the design department in division headquarters in Sacramento and in 1955 became chief assistant engineer of design.



GEORGE WEBB

Webb was born in Prineville, Oregon, and was educated in that State. He went to work for the Oregon Highway Department in 1919. In 1928 he came to California and worked as an instrumentman on the location surveys for the Feather River Highway.

Varied Assignments

From 1929 to 1937 he was a resident engineer on construction projects in the Redding district, then spent a year with the division's bridge department in Sacramento. From 1938 to 1942 Webb held various assignments in the Eureka district, including that of district traffic engineer.

From 1942 to 1953, except for 2½ years as an officer in the Army Transportation Corps in World War II, Webb was an assistant traffic engineer and assistant planning engineer at the division's Sacramento headquarters. He was promoted to traffic engineer in 1953.

TWENTY-FIVE-YEAR LIST

The following employees received 25-year awards since the September-October issue of the magazine.

Headquarters Office

Clyde I. Basler
William B. Carter
"Joe" Palmer
Stephen S. Pavitt

Bridge Department

Edward M. Derby

Materials and Research Department

Jessie E. Early
Gifford V. Stafford

Headquarters Shop

Leland Lane Wall

Shop 6

Ida M. Noble

State-owned Toll Bridges

George P. Higgins

District II

Ellis C. Engle
Robert A. Murry
Phyllis A. Pollard

District IV

Will F. Bruning
George W. Lee
George L. Richardson
Gum Y. Wong

District V

Frances Marjorie Fisher
Paul W. Freeborn

District VI

Winfred Earl Thomas

District VII

Richard E. Deffebach

District VIII

Dana A. Yates

District IX

Henry C. McAllister
Matias Perez

District X

Glenn H. Barr
M. F. Mason
John J. Quinn
Robert R. Westphal

Skidproofing

Deck Roughening Carried Out At Night to Minimize Delays

By R. D. KINSEY, Assistant District Engineer



The deck of the El Cerrito Overhead in the City of Albany on U.S. Highway 40 was recently serrated in order to provide increased surface traction in wet weather.

The El Cerrito Overhead was originally constructed in 1936. This structure is now carrying three lanes of northbound traffic as part of a six-lane freeway. Due to very heavy traffic through this location, now in excess of 37,000 vehicles per day, the bridge deck had lost some of its surface resistance.

Previous experiments have been satisfactorily carried out in District X at Turlock and District VI at El Tejon, both on U.S. Highway 99. These indicated that small grooves cut longitudinally in the deck would materially increase any traction when the surface is wet.

Commission Allots Funds

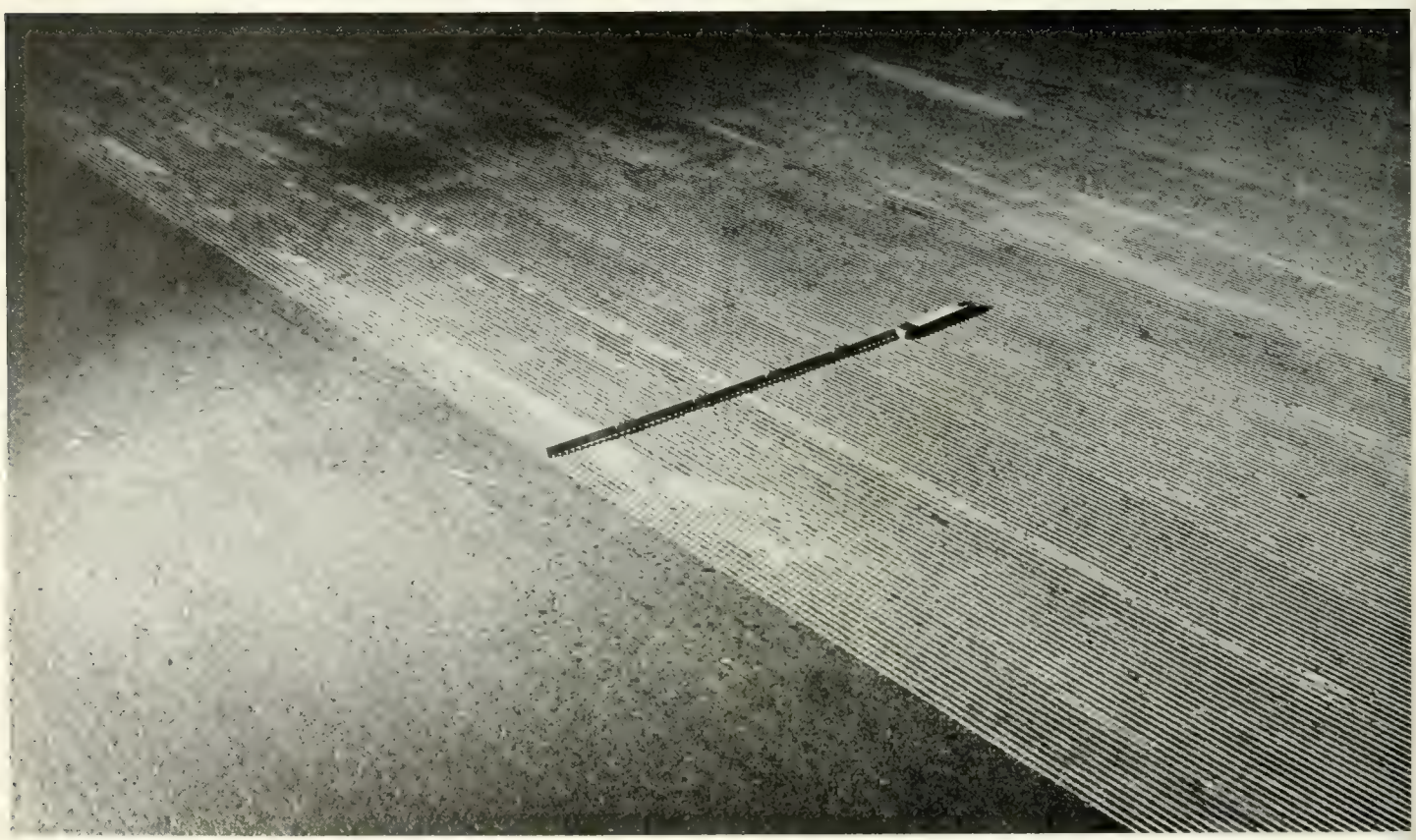
The California Highway Commission allocated funds on June 26, 1962, in the amount of $16,500, to provide for 81,000 square feet of deck roughening. The roughening was performed by using a concrete bump cutter with ⅛-inch wide diamond faced saws spaced $\frac{3}{16}$ inch apart and in a gang saw 24 inches in width. Cutting operations required twenty passes for the entire width of the bridge, which is 1,500 feet in length.

Before work was started on this surface, extensive investigation was made as to the hours of minimum traffic load. It was determined that the only time it was possible to reduce the number of traffic lanes on this structure would be during the night between the hours of 8 p.m. and 6 a.m. All work on the structure was performed between these hours commencing at 8 p.m. on Monday and completing at 6 a.m. on Saturday.

Skid Resistance Increased

Skid resistance tests made after completion indicated that resistance had been increased with a minimum coefficient of friction of 0.26 and a maximum of 0.35, the average being 0.32. On this project ⅛-inch wide cutter blades were used, and a spacing of $\frac{3}{16}$ inch apart was determined as the best for the desired results.

A closeup of the bridge deck after a section (right) had been cut to increase skid resistance.



Important features of the machine operation and speeds have not been evaluated here. Costs of this method will vary as a function of the speed of operation of the equipment. In this case higher costs than usual resulted because of the nighttime operation and heavy traffic conditions. On this project the total final costs were $13,800. This represents a cost of $0.16 per square foot.

The results of the operation were very effective and indicate that the worn surface of concrete can be satisfactorily made more skid resistant in wet weather by this procedure.

Harry Mathewson

J. Harry Mathewson, Assistant Director of the Institute of Traffic and Transportation Engineering at the University of California at Los Angeles, died on October 11, 1962.

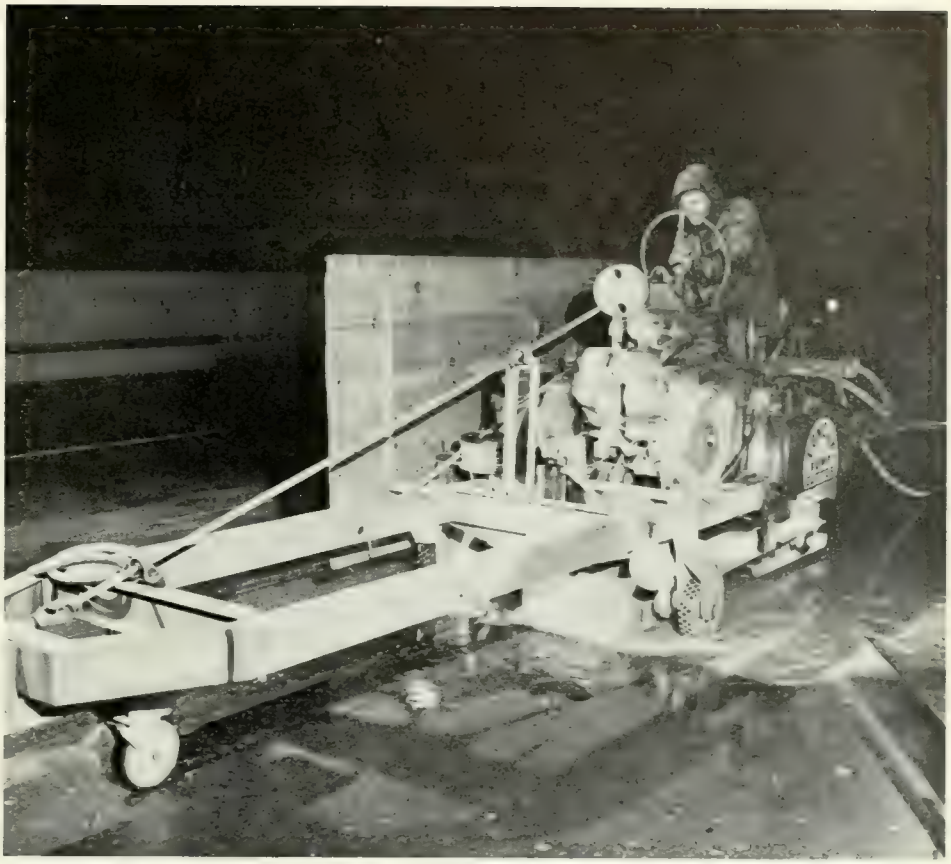
He played a leading role in the development of the institute's research activities, including the Los Angeles group's major contributions in the fields of automobile collision research and driving simulation.

Mathewson aided in many co-operative studies with the State Division of Highways, one of the most recent being the bridge rail testing in conjunction with the bridge design of the San Francisco Skyway.

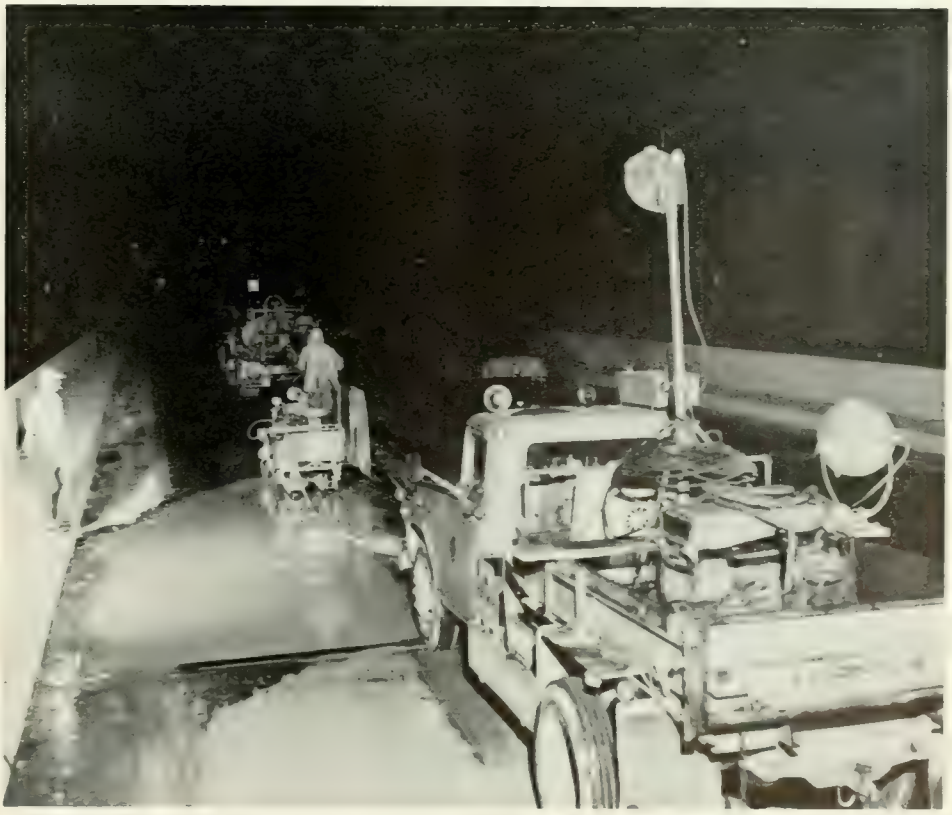
Mathewson was born in Scotland in 1899. He was graduated with honors from the University of Michigan in 1931. From 1931 to 1942 he spent five years teaching at the University of Toledo and six years in private engineering. He obtained his M.S. degree in engineering in 1938.

During World War II he served as safety consultant to the U.S. Air Forces for two years, then in the grade of lieutenant commander as assistant head of the Safety Branch, Navy Department, from 1944 to 1946.

He joined the University of California at Los Angeles in 1946, holding the National Safety Council professorship in engineering. He participated in establishing the ITTE at Los Angeles, being appointed assistant director in 1948.



A closeup of the cutter used in the surface cutting operations.



A photo of the train of equipment used showing the water supply truck in the background and the cutter and light truck in the foreground.

Lady Engineers

Professional Role of Distaffers In Highway Work Increasing

By LOUISE GOHDES, Assistant Information Officer

California's Division of Highways employs women engineers ranging from the associate level down to junior civil engineer—and may soon have women stepping up into the ranks of senior highway engineer. A capable woman "mans" the position of personnel officer for this agency of 16,000 employees. And still other women hold responsible positions in various categories.

Far from being an innovation, this situation has existed since 1948, when Marilyn Jorgenson, with a brand new degree in civil engineering from the University of Minnesota, received her appointment as junior civil engineer in Los Angeles. And although now the division has quite a number of women in the profession (District VII—Los Angeles, Ventura and Orange Counties—alone has eight associate and assistant engineers of the fairer sex), Marilyn has chalked up a few firsts. She was the division's first woman to become associate highway engineer, and she was the first woman squad boss in charge of a design crew.

Associate Highway Engineer Ann Hansen looks up from notes as she reviews a scale model of future District IV freeway project. Technical reports and research are a major part of her work in Traffic Engineering.



In 1957 Marilyn became Mrs. Alvin Reece, and is now the mother of four-year-old Kirsten—blonde, like her mother. How does *Mr.* Reece react to his wife's being an engineer? He's proud! And he himself is an engineer—with the Los Angeles County Flood Control District.

Designs Interchanges

Back to Marilyn, and what she does. She's recently gained distinction through supervising the design of the three-level San Diego-Santa Monica Freeway Interchange, with new high-speed ramps. Both the San Diego and the Santa Monica are interstate system freeways.

Because speed standards for on- and off-ramp traffic flow were recently upgraded, Marilyn reworked angles of curve radii to accommodate speeds of 50-55 miles per hour. This was only one of many changes with which she had to deal as new specifications were developed. She says that the present design was finally approved 2 years—and 30 preliminary plans—after the project was originally assigned to her.

Because plans had to be drawn around a school, a church, a sanitarium, and several large apartment buildings, the design presented additional challenges. Eight people worked with her on the project. As now designed, the southbound San Diego to westbound Santa Monica link of the freeway marks it as the largest single span branch connection in the state's highway system. Since acceptance, her plan has been used as a prototype of bigger and better interchanges to come.

Lifetime Work

Marilyn finds the work so interesting that she expects to stay at it "for the rest of her working days." She finds it extremely satisfying to see the fruits of her labors take form in steel and concrete. And her efforts are now bent toward advancing to senior highway engineer. She feels that women



Associate Highway Engineer Marilyn Reece, who supervised design of 3-level San Diego-Santa Monica Freeway Interchange in Los Angeles, has on-site discussion with Assistant Resident Engineer Thomas McKinley.

have a definite advantage in the field of engineering, and, says she, "if there's any prejudice toward women, I've not encountered it. Men have always been very helpful; and being a woman has never hampered me in my career."

Then there's Carol Schumaker, slender, brunette, and 32 years old. She, too, is an associate highway engineer; has been with the division for eight years, and is eligible for appointment to the position of senior highway engineer by virtue of having passed the required civil service examination. Via night classes, she's working on her master of science degree which she expects to receive by June of 1964.

Her desire to become an engineer had already formed in high school, because of her liking for math, physics, and the sciences. Following her course at Purdue University, she graduated of study at Purdue University, she graduated in 1952, with the degree of B.S.C.E. About half way through her senior year she married Bernard Schumaker—also a Purdue graduate, and also an engineer.

Husband a Teacher

Bernard has recently taken leave of active engineering to become a high school math teacher at Garden Grove. But Carol remains in highway work. At the present time her main project is working out plans for another segment (she's just completed work on one segment) of the San Diego Freeway. This is a 4.8-mile section near the San Gabriel River which will incorporate several important interchanges. The biggest thing she's been involved in is the interchange of the San Gabriel, Garden Grove, and San Diego Freeways—a really big interchange near the Los Angeles-Orange county line. Although only two levels, it has many complicated connections.

Outsiders who make appointments with an engineer by the name of Schumaker invariably do a "double take" when they find themselves face to face with a 5-foot-2 miss who weighs scarcely more than 100 pounds.

The Schumakers take son Paul (age 9) on carefully planned vacation trips



Noting District VII's freeway progress, Associate Highway Engineer Carol Schumaker indicates one of the project locations in Los Angeles County. Design is Carol's present assignment, following several years each in Advance Planning and Drainage Departments.

each year. Last year, of course, it was the Seattle World's Fair.

12 Female Assistant Engineers

There are still other lady engineers in District VII. Six hold the rating of assistant highway engineer, only one civil service class below Marilyn and Carol. Other districts, too, have women in this classification—making a total of 12 women assistants throughout the State.

In San Francisco, Ann Hansen has recently returned from a leave of absence for a European tour, to reoccupy her post as associate highway engineer in District IV. She believes Italy to be doing most in multilane highways—all toll—and mainly around Milano, which has become quite an industrial center. While in London, Ann visited the Road Research Laboratory, which is part of Britain's Department of Scientific and Industrial Research. With their staff she discussed their studies covering many phases of accidents, traffic, and safety.

Being in District IV's traffic department, Ann writes technical reports, conducts research, and analyzes data. She, too, has passed the exam for senior highway engineer, having started as junior civil engineer in 1951, just after graduation from University of Utah. Following experience in planning and design, Ann spent 3½ years on two important construction projects: the Waldo approach to the Golden Gate Bridge, and the Marin approach to the San Rafael-Richmond Bridge. In addition to inspecting all fencing and curb work, electrical items and all utility relocation and installation, she co-ordinated work among the various utility companies, subcontractors, and prime contractor.

Skiing, Cooking, Dogs

Ann's outside interests reach in many directions, among them skiing, swimming, cooking, interior decorating . . . and dog training! She regularly gives much time to work at San Rafael General Hospital. Ann has also done a good bit of modeling—now shelved, as she prefers to concentrate her energies on her job. In connection with her interests she served as president of the Marin chapter of the National Society of Professional Engineers; and she's just applied for membership in the Society of Women Engineers—also a national organization. Also, she's applying for a higher grade in the Institute of Traffic Engineers.

Further demonstrating the effectiveness of women "in high places" is Marian Smith, personnel officer for California's Division of Highways. Having begun in highways personnel on a two-week emergency basis after her graduation from Stanford in 1941, she stayed for about a year and a half, at which time she felt her country's call to duty. For four years she served in the WAVES, attaining the rank of lieutenant. Returning to civilian status, she again found her niche in the personnel department, as personnel analyst. In 1955 she became personnel officer, and as such she supervises the personnel program for the division's 16,000 employees in 348 different classifications in 27 locations.

Busy Job

The duties of a personnel officer sound overwhelming, and almost are to the layman. Just a half-hour in Marian's office, punctuated with phone calls, gives one an idea of what comes across her desk. People call in from everywhere: throughout the

State, other state agencies, and throughout the building. There are questions involving union labor. There's the problem of a state-employed mother who would like to relocate for reasons of her children's health. There are deliberations on sick-leave interpretation. On occasion, she is a "convenient shoulder to cry on," for both supervisors and employees.

A great deal of Marian's time goes into analyzing positions, classifications, and salaries, and keeping tab on the "changing scene" to meet current personnel needs. For example, she's currently involved with the reorganization of the division's accounting department on a statewide basis, and thus dealing with both administrators and employees as to duties, workflow, and similar matters. Last year a new series of classifications for maintenance men was established, clarifying job status, and also recognizing the changing skill requirements in this field. A similar revision is in the offing for landscape workers. In 1961 a series of engineering technician classes was established.

Must Predetermine Needs

Marian must predetermine employment needs of all sections within the division, seeing that adequate eligibility lists exist, and requesting civil service exams to be scheduled as required. To keep personnel activities running smoothly throughout the State, Marian visits each of the 11 districts and the toll bridge headquarters approximately twice each year. She was 1961 chairman of the State Personnel Officers Council, which comprises personnel officers of all state agencies and meets once each month to discuss various phases of the state personnel picture.

Among Marian's many continuing responsibilities are performance appraisal programs, along with development of improved work standards and methods. There's many a discussion with employees regarding opportunities to advance. All get genuine consideration from Marian whatever their problem: funny, trying, or challenging.

Slim, Alert, Friendly

Hitching it of this, and still more, the slim, alert, and friendly Miss Smith still finds time for outside activity. She's active as a Sunday School superintendent, and active also in the American Association of University Women. During vacation she travels; and has already been to the Orient, to Europe, and Central America. In 1951 Marian spent six months at Mexico City College, studying international relations and Spanish.

Of the staff of personnel analysts who aid Marian in reviewing classifications and salaries, and in similar duties, several are women. Women also hold jobs in such responsible classifications as accounting officers, professional accountants, research statisticians, delineators, and in other specialized division functions, as well as in clerical posts. All told, California's Division of Highways employs well over 2,000 women, and offers great professional opportunity.

Department Awards Big U.S. 99 Contract

The State Department of Public Works has awarded a $4,331,722 contract to Fredrickson & Watson Construction Co., Oakland, for grading and paving 6.8 miles of four-lane freeway on U.S. 99 (Interstate 5) between 4.6 miles south and 1.5 miles north of Mount Shasta city limits, Siskiyou County. The freeway will be generally west of the city. Included in the project is construction of overcrossings at Azalea Road, South Mount Shasta, Ream Avenue, Lake Street, Lassen Lane, and North Mount Shasta; a pioneer overhead taking the highway over the Southern Pacific Railroad tracks; and an interchange at the junction of U.S. 99 and State Sign Route 89. Other structural work has been under way since October on a separate contract.



Personnel Officer Marian Smith examines the latest Division of Highways staffing pattern with Personnel Analysts Laura Cameron (left) and Joan Weckesser. Charted statistics help Marian and her aides recommend appropriate staffing in various districts.

Fossil Find

Contractor's Crew and Division of Highways Men Work Together and Conserve Ancient Relics



Martha Laird, Division of Highways employee, poses holding fossilized section of Hipparion jawbone and teeth, in order to show size of piece.

Workers in the contractor's force and two members of the Division of Highways resident engineer staff were commended by University of California scientists recently for their alertness when they preserved valuable fossils found in the bore of the new Caldecott Tunnel east of Oakland. Paleontologists from the University of California were called to the scene in a matter of hours, and expressed considerable gratitude over the find.

Dr. Donald E. Savage, Curator of Higher Vertebrates in the Museum of Paleontology at the university, said, "The really interesting thing is that these workmen, without any special knowledge and working in semidarkness, were able to recognize these fossils as something other than ordinary rocks."

The tunnel, passing through the base of the Berkeley Hills, transects strata of geological ages from recent to as far back as Jurassic, but it was the Orinda formation in which the fossils were found. This is a stream floodplain deposit of early Pliocene age, about 10 to 12 million years old, laid down at a time just preceding the eruption of a few small volcanos in the Berkeley Hills area.

One group of fossils, after being cleaned and fitted together by the university paleontologists, was tentatively identified as the tibia from the legbone of an extinct rhinoceros. This rhinoceros, called *Aphelops*, was more slender limbed and possibly fleeter of foot than its modern counterpart. Although extinct for about 4 million years, it was fairly common in the vicinity at that time, but there was no "Bay area" as we know it today. The Berkeley Hills probably were only low islands or a northward-projecting peninsula in a shallow sea extending toward the base of the Sierra Nevada.

Found in company with the *Aphelops* fossils were two sections of jawbone from a primitive member of the



Above: John S. Maestas, employee of Connolly Pacific, one of joint venture firms doing tunnel job, shows place fossils were found. Division of Highways employees Charles Yakabe, junior civil engineer, and Paul Carnahan, engineering aide, assisted in find.

Below: Pieces of leg bone of long extinct rhinoceros, Aphelops, after being joined together by University of California paleontologists.



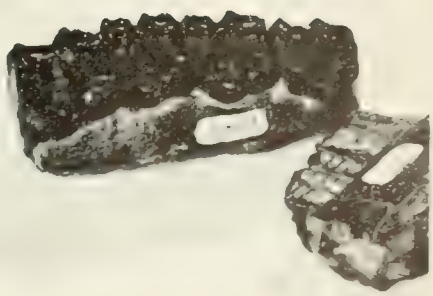
Hipparion group, an early species of the three-toed horse. This find was termed "tremendously important . . . from the scientific viewpoint" by Dr. Savage, as it fortified other fragmentary evidence of a hitherto unknown species in the development of the horse. A later species of *Hipparion*, somewhat heavier than, but about the size of a mule deer, is known to have once been present in California in great numbers.

The fossils will eventually become the permanent property of the University of California. Since the find was made on the preliminary bore of the new tunnel, there is hope that more fossils will be found at the same point when the tunnel is increased to its full size.

Since new construction of bridges, tunnels, and highways quite often turns up materials of paleontological or anthropological value, such discoveries are not new to Division of Highways and contractors' personnel. All resident engineers are instructed as to procedure in such cases, and whenever possible work is held up until scientists can get to the scene.

Close liaison is also maintained with Division of Beaches and Parks specialists, who often advise or take over conservation of sites. Under a joint agreement with this agency, the Division of Highways contributes an average of $15,000 each year for excavation and salvage at these sites.

Below: Two small pieces of Hipparion jawbone not exceeding three inches in length, support identification of new species.



Highway Exhibits

Information Displays Draw More Viewers

By BARRY COHON, Assistant Information Officer



Visual information exhibits, long used to good advantage in connection with local freeway route hearings, are now finding increasing acceptance as general public information. These exhibits, designed to promote understanding of the highway program and safety on the road, reached an estimated 200,000 people in the Los Angeles area during October and November 1962.

Largest Exhibit

District VII placed its largest public exhibit to date on two floors of the Los Angeles Public Library, from September 27 to November 13. Some 140,000 library visitors saw this exhibit, which covered various aspects of the California highway program, its history, procedures, and scope (accenting Southern California), in maps, charts, and photographs especially assembled in a display designed to fit the library's scattered exhibit areas.

Literature Distributed

An estimated 18,000 pieces of literature were distributed at the library during the six weeks of the exhibit.

A delegation from Taft (Kern County), visited the Highways exhibit at the Los Angeles Home Show last July, which featured the scale model of the Santa Monica-San Diego Freeway interchange. The Taft people requested a similar exhibit for their own home show in October.

Scale Model Included

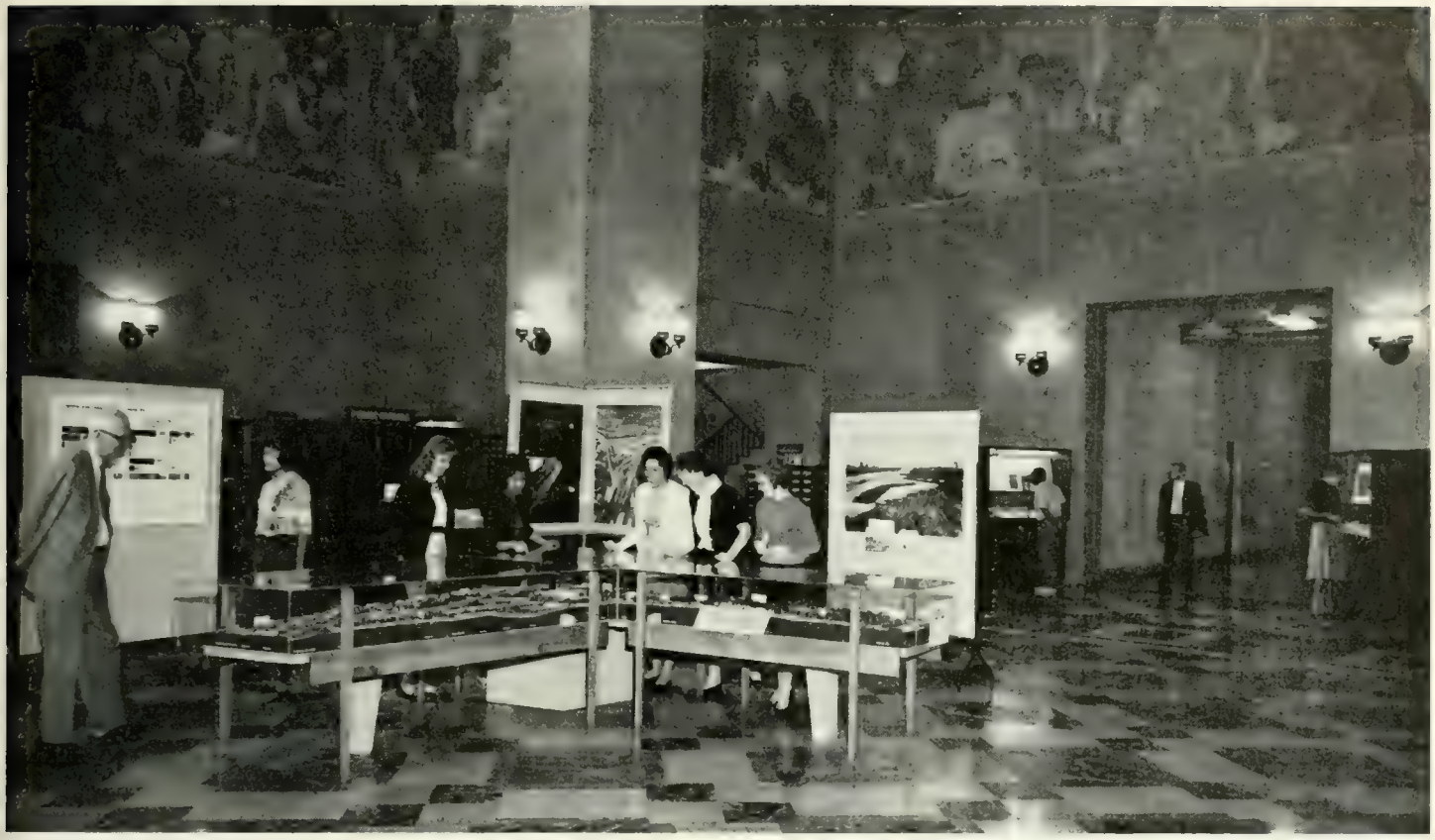
Accordingly, by co-operation between District VII and District VI, Fresno, the exhibit was assembled to include the same scale model, since many citizens of Taft use the Los



This exhibit was set up on the second-floor lobby of the Division of Highways district headquarters building at 120 South Spring Street in Los Angeles.



An exhibit on the Los Angeles Regional Transportation Survey was set up for the American Institute of Planners at the Statler Hilton Hotel in Los Angeles.



The exhibit in the second-floor rotunda of the Los Angeles Public Library. The model in the case in the foreground is of the East Los Angeles Interchange.

Angeles freeways weekly, plus a photographic display of highway activities in District VI, and general information literature. At the close of the Taft Home Show, District VI displayed the exhibit at its home office.

The District VII information section also exhibited October 11 through 14, at the Los Angeles Mobile Home and Trailer Show, which attracted an estimated 40,000 people. This exhibit, featuring specially prepared charts, maps and photographs, was reassembled and is now installed on the second floor of the Highways Building in the right-of-way section lobby.



This exhibit, also at the Los Angeles Public Library, is in the second-floor elevator area. The wall cases hold photo blowups of highway construction in Southern California.

Special Exhibit

The American Institute of Planners convention at the Statler Hilton Hotel was the setting for a special exhibit demonstrating the work of the division's advance planning section in connection with the Los Angeles regional transportation study. Approximately 1,500 people visited this display. Dick Withers of advance planning designed this exhibit and attended it throughout the convention, October 15-17.

Public Response

Public response indicates that even casual visitors to these exhibits find quick answers to their questions about the highway program, expressed in graphic form there and supplemented by take-home reading matter.

More Routes

Freeway Mileage Adopted By Commission Now 6,358

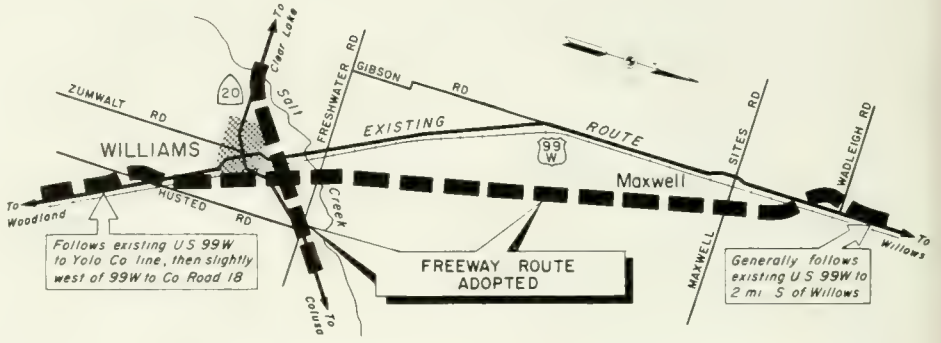
At its last four monthly meetings of 1962 the California Highway Commission adopted 20 routings for a total of 154.3 miles of freeway and declared another 9.3 miles of existing highway to be a freeway. This brought the mileage of adopted freeway routes in the State to 6,358.2 miles. The commission also adopted routings for 5.5 miles of conventional highway.

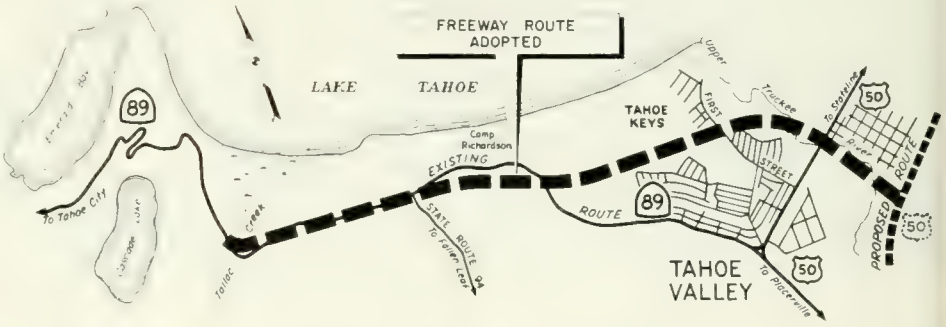
Three of the freeway route adoptions involved public hearings by the commission. These routings are for 2.6 miles of U.S. 101 in the Novato area of Marin County, for 6.9 miles of Sign Route 23 (Moorpark Road) in Ventura County and for 5.8 miles of the San Gabriel River Freeway in Los Angeles County and the Cities of Baldwin Park and Irwindale. Cities and counties affected waived commission hearings in the 17 other adoptions.

The longest freeway route adoption was for 39.7 miles of U.S. 99W in Yolo, Colusa and Glenn Counties and the shortest 0.3 mile to bring Sign Route 120 in Tuolumne County to the Yosemite National Park boundary.

The September, October, November and December freeway route adoptions:

Colusa County—3.8 miles of Sign Route 20 in the Williams area.



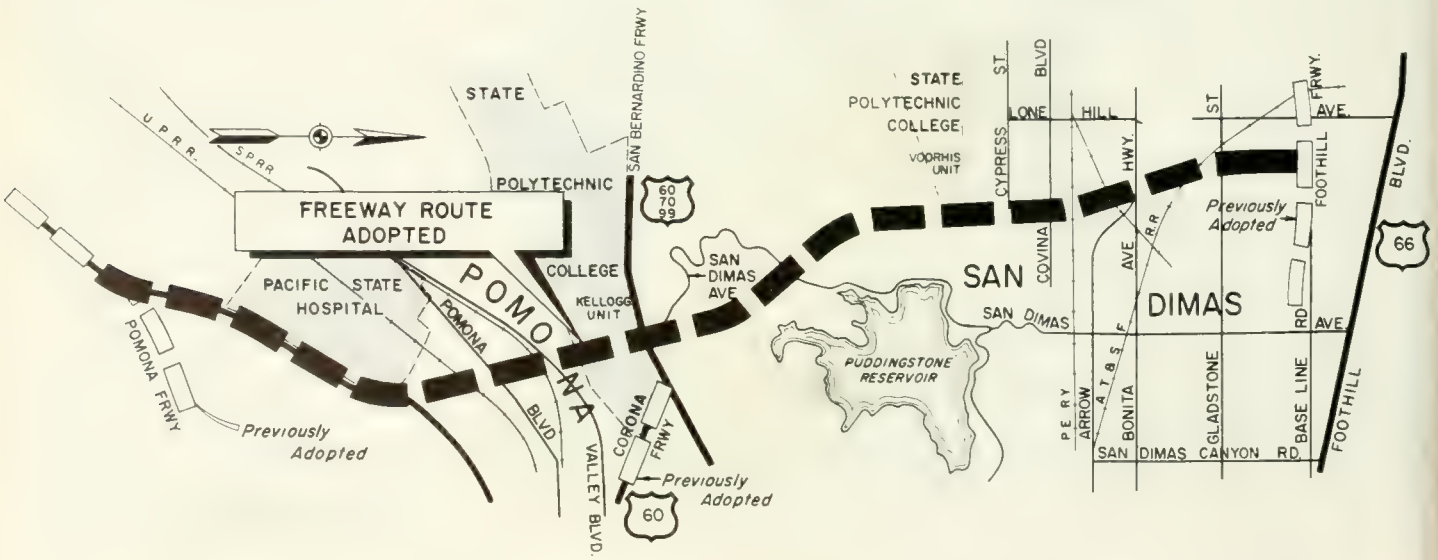


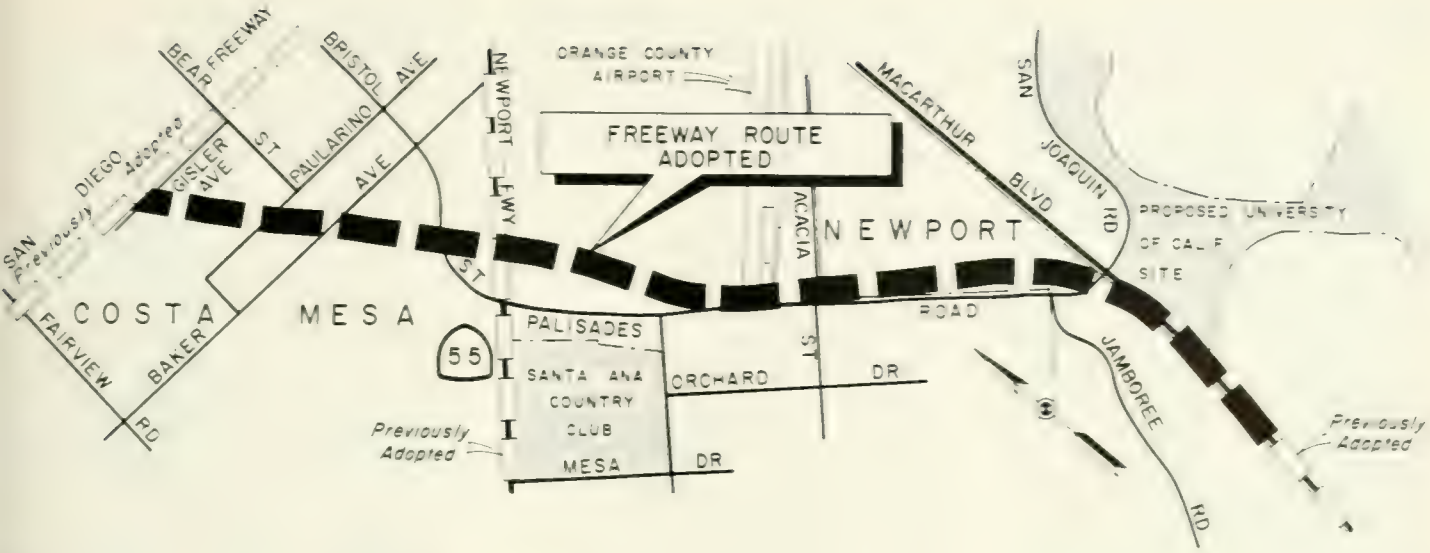
El Dorado County—4.6 miles of U.S. 50, revising previous routing to accommodate extension of Lake Tahoe Airport.

El Dorado County—5.8 miles of Sign Route 89 between Tallac Creek and the adopted route for U.S. 50.

Los Angeles County—8.7 miles of the Route 240/272 Freeway in the county and the Cities of Pomona, San Dimas and Glendora.

Los Angeles County—5.4 miles of the San Gabriel River Freeway in the county and the Cities of Baldwin Park and Irwindale between the San Ber-





nardino Freeway and the adopted route for the Foothill Freeway.

Marin County—2.6 miles of U.S. 101 in the Novato area of Marin County.

Mendocino County—5.1 miles of Sign Route 1 between Russian Gulch State Park and 1.6 miles north of Jughandle Creek. Initial construction as modern two-lane highway.

Modoc County—26.2 miles of Sign Route 139 between U.S. 299 near Canby and 1.5 miles south of Perez. Planned as initial two-lane expressway.

Mono County—10 miles of U.S. 395 on the Sherwin Grade section between the Inyo county line and Whisky Canyon. Route mostly follows the existing highway.

San Mateo County—1.9 miles of State Highway Route 105 between Skyline Boulevard at Cahill Ridge near the intersection of Half Moon Bay Road and the adopted route for the Junipero Serra Freeway in the vicinity of Ralston Avenue.

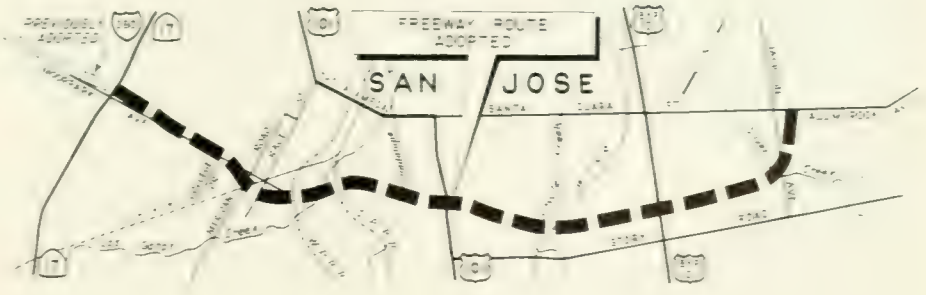
Santa Barbara County—Freeway bypass of Orcutt on State Highway Route 2. Length 1.7 miles, running to the south of Orcutt.

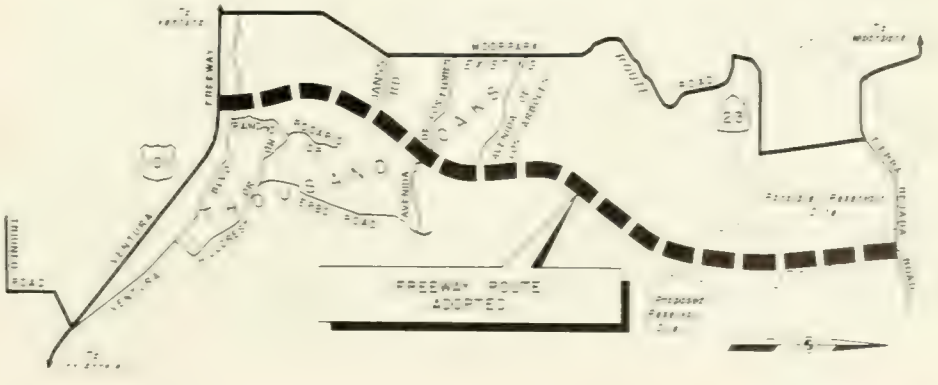
Santa Barbara County—13.2 miles of Sign Route 1 between two miles north of the Santa Ynez River and 1.4 miles west of Orcutt.

Santa Clara County—7.4 miles of State Highway Route 5 in the San Jose area between Sign Route 17 and Alum Rock Avenue.

Continued on page 56







STATE'S RELOCATION, COMPENSATION POLICY PRAISED

(Reprinted from Los Angeles *Times*, December 6, 1962)

California got a pat on the back Wednesday from Senator Williams (D–N.J.) for its program of compensating and relocating persons, especially the elderly, whose properties are purchased for freeway rights-of-way and other public uses.

After hearing testimony that the California Department of Public Works' Highway Right-of-way Division has relocated 115,000 persons in the last 10 years with a minimum of discomfort, Senator Williams, Chairman of the Relocation Subcommittee of the Senate Special Committee on Aging, said:

"California is to be complimented for acting on such eminently sound and humane principles. Such a program certainly reduces the inevitable traumas encountered by the elderly displaced by public progress."

Daylong Hearing

Dexter MacBride, Division of Highways engineer, appearing as the first witness at the subcommittee's daylong hearing on relocation problems in Room 1138, New State Building, testified:

1. The State is buying about 10,000 parcels and spending $200 million annually in acquiring private property for public use.

2. Of those 10,000 parcels, 5,000 are in residential use and 60 percent (3,400 last year) were owner-occupied. The average dwelling acquired by the State through condemnation or negotiation was 27 years old, was valued at $11,200, and was the residence of two persons.

3. Of the dispossessed owners, 61 percent bought replacement housing with State assistance. Replacement dwelling averaged 10.6 years old, were valued at $14,412.

Moving Costs Low

"Thus you can see the dynamic impulse of these dispossessed elderly persons to upgrade their housing when they have the right opportunity and assistance," MacBride testified. "The average moving cost was only $36.

"The magic which California has applied to these serious relocation and land acquisition problems is simply this: allow enough 'lead' time to meet all the hardships involved.

"We find that the elderly citizen usually is more self-reliant and does a better job of taking care of his relocation problems than the younger people."

Also testifying before the Williams subcommittee were:

Joan Flor, Redevelopment Agency of Santa Monica; Margaret Watkins, Los Angeles Community Redevelopment Agency; Mrs. Benjamin Borchardt, President of Allies Senior Clubs, Inc.; and George McLain, Chairman, California League of Senior Citizens.

MORE ROUTES

(Continued from page 56)

Santa Clara County—2.7 miles Sign Rte. 292 (Guadalupe Freeway) in San Jose between Coleman Street and U.S. 101 Bypass (Bayshore Freeway).

Siskiyou County—3.2 miles of U.S. 99 in the vicinity of Weed.

Tuolumne County—0.3 mile of Sign Route 120 (Big Oak Flat Road) between one mile west of Carl Inn and the Yosemite National Park boundary.

Orange County—3.9 miles of State Highway Route 184 (MacArthur Boulevard) in the county and Cities of Newport Beach and Costa Mesa.

Ventura and Santa Barbara Counties—1.2 miles of U.S. 101 between a quarter of a mile east of the Ventura-Santa Barbara county line and 0.2 mile north of Sign Route 150.

Ventura County—Relocation of 6.9 miles of Sign Route 23 (Moorpark Road) between the Ventura Freeway and Tierra Rejada Road.

Yolo, Colusa and Glenn Counties—39.7 miles of U.S. 99W (Interstate 5). In Yolo County, between the Dunnigan cutoff and Colusa county line, 6.3 miles. In Colusa County, between the Yolo county line and Sign Route 20, near Williams. In Colusa and Glenn Counties, between Maxwell-Colusa Road and two miles south of Willows, 14.6 miles.

District I Office Loses Rudy Bergroth

Rudolph Bergroth, office engineer for the District I office of the Division of Highways in Eureka, retired on February 1 after 35 years with the State.



RUDOLPH BERGROTH

Bergroth joined the District I office in Willits as a civil engineering draftsman in 1928. Later he served on survey parties as construction inspector, and then as assistant resident and resident engineer on several highway construction projects.

From 1935 to 1936 he was assigned as cable wire and concrete plant inspector on the San Francisco-Oakland Bay Bridge construction after which he returned to District I. His assignments from 1936 to 1943 included chief of party on preliminary route surveys, resident engineer of resurfacing projects and chief draftsman for the district.

He later served as district traffic and safety engineer, city co-operative engineer and permit engineer. He was appointed district office engineer in 1953.

Born in San Francisco, Bergroth completed grade and high school there and went on to study at the Polytechnic College of Engineering.

Bergroth and his wife, Lorene, who is a teacher, plan to spend some time traveling after his retirement. They will maintain their home in Eureka.

OOPS!

In spite of normal precautions, gremlins managed to gain access to the September-October copy of the magazine and transfer the name of Robert N. Smith, District III highway engineering associate, from the retirement list to the obituary column.

The editor is happy to say that Mr. Smith is alive and well and that, in line with the classic statement of Mark Twain, the report of his death was greatly exaggerated.

EARL E. SORENSON RETIRES; JOHN BEATON IS NAMED

Retirement of Earl E. Sorenson as equipment engineer for the California Division of Highways and the promotion of John L. Beaton to succeed him has been announced by State Highway Engineer J. C. Womack. Beaton is chief of the structural materials section of the division's materials and research department.



Earl E. Sorenson is presented with a certificate of appreciation from the Division's Safety Committee by C. E. Waite, Deputy State Highway Engineer. Sorenson is a charter member of the committee.

For the past 14 years of his 34-year state career, Sorenson has been in charge of the trucks, automobiles and specialized maintenance and construction equipment operated by the Division of Highways, now totalling about 9,400 units and an investment of more than $33,000,000. This equipment is serviced and repaired at 12 major shops and 14 sub-shops throughout the State.

The equipment department is also responsible for procuring automotive and maintenance equipment, and, in many cases, for designing and constructing specialized vehicles and machines for highway work.

Sorenson is a native of Harlan, Iowa. In World War I he served with the 20th Infantry on the Mexican border and then as a pilot in France with the 263d Air Service.

After the war he worked as a construction superintendent in his home city of Harlan. He graduated from the University of Nebraska in 1925 with a B.S. degree in civil engineering.

In the same year he went to Venezuela, where he was in charge of the hydrographic and topographic surveys for a petroleum firm and made the surveys and base map for the present city of Maracaibo.

In 1926 he returned to the United States to become senior projects engineer for the Nebraska Department of Public Works, then moved to California in 1928 and joined the Division of Highways as resident engineer on construction jobs in the San Francisco Bay area.

He was appointed maintenance engineer for District XI, San Diego, in 1933, and from 1935 to 1947 supervised the construction contracts for that district. In 1948 he was advanced to his present position as equipment engineer and transferred to division headquarters in Sacramento.

Sorenson is married to the former Rose Mae Heyden. They have two sons, Charles, a California Highway Patrol officer, and Ronald, a mechanical engineer.



JOHN L. BEATON

Sorenson is a member of the American Society of Civil Engineers, the American Public Works Association, the Ambassadors and Commonwealth Clubs and the Masonic order. He is a past president of Chapter 17, California State Employees' Association in San Diego, and a past regional director.

Beaton, Sorenson's successor, is a veteran of more than 25 years service with the State of California.

He joined the Division of Highways as a rodman and axeman on the Kings River Canyon project in 1930 and worked for the division during summer vacations while he was attending the University of California. Upon graduation in 1937 he was assigned to the division's bridge department.

In 1945 he joined the State Personnel Board as senior engineer examiner.

In 1949 Beaton returned to the Division of Highways as a senior highway engineer and in 1950 became personnel management assistant for the division.

Since November 1951 he has served as supervising highway engineer for the materials and research department in charge of the structural materials section. In Janury 1962 he was elected president of the Sacramento Section, American Society of Civil Engineers.

Beaton is the author of professional papers which appeared in the proceedings of the Highway Research Board and covered such subjects as testing of concrete bridge rails, extensive full scale tests of median barrier designs, causes and repair of bridge deterioration due to corrosion, radiographic inspection of welded highway bridges, and corrosion of metal culverts. He has also had papers published in the ASCE transactions covering structural welding inspection and inspection and testing of welding on highway bridges.

Beaton and his wife, Rosina, have two children: Richard, 19, and Judy, 14.

E. F. Carter Retires, Ends 44-year Career

After 44 years of service with the Division of Highways, Assistant Maintenance Engineer Edward F. Carter retired from state service on December 1.

Carter began his state highway career as a teamster in Inyo and Mono Counties in 1918, and became a survey crew member in 1921. He later advanced to survey party chief and resident engineer. In 1926 he became assistant maintenance engineer in District V, San Luis Obispo.

In 1941 Carter was transferred to division headquarters in Sacramento. For the past 15 years he has been in charge of the budget section of the division's maintenance department, where he has achieved extensive improvement of maintenance cost accounting procedures.

Recent Department Retirements Listed

Headquarters Office

Frank M. Reynolds, principal highway engineer, 33 years; Hazeldean M. Snedden, senior information clerk, 20 years.

Bridge Department

Lelia W. Houde, supervising stenographer I, 15 years; George L. Laird, supervising bridge engineer, 24 years.

District I

Charles Cuff, highway foreman, 43 years; Otto W. Heinrich, senior highway foreman, 26 years; Archie R. Mitchell, highway foreman, 29 years; * Howard E. Raymond, highway maintenance man II, 27 years; Charles W. Travis, highway maintenance man II, 29 years.

District II

Richard S. Juvet, highway field office assistant, 25 years.

District III

Martin H. Barner, highway maintenance man II, 31 years; Robert Edwards, highway field office assistant, 12 years; Raymond Hardy, janitor, 9 years; Robert M. Luck, highway maintenance man III, 33 years; Daniel M. Vierra, highway maintenance man I, 29 years.

District IV

Horace M. Hair, supervising groundsman I, 15 years; Jesse Miller, highway maintenance man I, 11 years; Thomas J. Murray, highway maintenance man I, 29 years; George L. Richardson, supervising traffic signal technician, 25 years.

District V

Eugene C. VanSchaick, highway foreman, 31 years.

District VI

Edward R. Obrikat, assistant highway engineer, 15 years.

District VII

Wilbur W. Feineman, associate right-of-way agent, 13 years; Stillman A. Gates, highway maintenance man II, 30 years; Lawernce W. Larson, assistant highway Engineer, 27 years.

District VIII

Roscoe Webb, highway maintenance man II, 24 years.

District X

Alex F. Petzinger, ferryboat captain, 5 years.

District XI

Carson McNamee, highway field office assistant, 27 years.

State-owned Toll Bridges

Joseph Rapisarda, highway maintenance man I, 4 years.

* Disability.

Assistant Comptroller W. S. Cully Retires

William S. Cully, assistant comptroller for the Department of Public Works has retired after 33 years of state service.

A native of Leadville, Colorado, Cully attended business school in Denver and began his career as a bookkeeper in a mine commissary at Climax.

He came to Sacramento in 1928 and went to work in 1930 as a junior bookkeeper for the Division of Highways. He was named assistant comptroller in July 1949.



WILLIAM S. CULLY

His special responsibilities have included the preparation of accounting manuals for the Division of Highways, Division of Architecture and the former Division of Water Resources in the Department of Public Works. He also set up the accounting procedures for state-owned toll bridges, supervised the budgets and accounts operation for the Division of Highways, and wrote the procedures for cities and counties to follow in filing claims for storm damage to roads, streets and bridges.

Cully and his wife, Agnes, have three children: Mrs. Alice Lera of Sacramento, Alan W. Cully of the merchant marine, and Dennis, a student at C. K. McClatchy High School.

L. A. Weymouth

L. A. Weymouth, district engineer in charge of operations for District IV, San Francisco, died December 4 after a long illness.

A native Californian, Weymouth was born in Pacific Grove and attended grade and high school in Madera and Fresno. He continued his studies at Fresno State College and received his B.S. degree from the University of California at Berkeley.

Weymouth's career with the Division of Highways started in 1928 when he went to work for District VI as a rodman. He was assigned to District V in 1931 as a highway draftsman computer and office man on a location survey south of Big Sur in Monterey County. He continued in District V until 1939, working on surveys, construction and design.

In 1939 Weymouth was assigned to surveys and plans department in headquarters office. Among other duties he reviewed plans in the field and office and assisted in developing the State's position on AASHO design policies.

During 1943 he was assigned to District I as resident engineer on an access road to an airbase southwest of Arcata.

Weymouth transferred to District IV in 1945 as freeway and advance planning engineer. He was promoted to district engineer in 1947, in charge of planning and design for District IV. He took over the operations function for District IV in 1952.

Weymouth was a member of the American Society of Civil Engineers and the Institute of Traffic Engineers.

He is survived by his wife, Margaret, and a son and daughter.

Shop 1

Martin Bredehoft, automobile mechanic, 36 years.

Shop 3

Marion L. Blackwell, senior machine parts storekeeper, 38 years.

Shop 10

Helen Parnau, accounting technician III, 30 years.

Greene, Ayanian Reassigned in S.F.

Clifton F. Greene has been appointed district engineer – planning, for the San Francisco Bay area district of the California Division of Highways, a position which has been filled since early this year by Haig Ayanian. Ayanian is being shifted to the post of district engineer—operations, succeeding the late L. A. Weymouth.



CLIFTON F. GREENE

For the past 13 years Greene has been assistant district engineer in charge of advance planning and route location studies for the San Francisco Bay area.

In his new assignment he will not only be responsible for these functions but also for programing and budgets and for administrative services.

A native of Waitsfield, Vermont, Greene attended high school in Petaluma, and received his B.S. degree from the University of California at Berkeley.

He joined the Division of Highways in 1931. His first three years were spent on construction and materials testing in the San Luis Obispo and Los Angeles districts, followed by eight years in design work in the San Diego district. He moved to District IV, San Francisco, in 1942.

He was promoted to district project and budget engineer in November 1947. He advanced to assistant district engineer in charge of planning in December 1949, and has since played a major staff role in the planning and design of the major freeways in the San Francisco Bay area.

Greene and his wife, Bonnie, have a son, Charles, and a daughter, Janet.



HAIG AYANIAN

Ayanian, in taking over the operations assignment for District IV, will have responsibility for the construction, maintenance and traffic functions and for engineering services.

Most of his 25 years of experience with the Division of Highways have been in the field of construction. After service with the Seabees in World War II, Ayanian was resident engineer on major freeway contracts in the Los Angeles area, and moved to San Francisco in 1956 as assistant district engineer in charge of construction. Early in 1962 he was promoted to district engineer—planning.

Ayanian is a native of Niagara Falls, N.Y. He attended the University of California at Los Angeles.

Equipment Super Mendenhall Retires

After 43 years of service with the equipment department of the Division of Highways, Thomas A. Mendenhall, highway equipment superintendent I at headquarters shop, Sacramento, retired on January 1.

Mendenhall started his career with the State in August 1920, as an automobile mechanic in headquarters shop.

With the exception of less than a year's separation, Mendenhall's career has been with the equipment department. In 1931 he was promoted to highway mechanic foreman.

In May 1955, he was promoted to highway equipment superintendent and given charge of the development of the special equipment designed and constructed in the headquarters shop.

Mendenhall was born in Salesville, Ohio, and attended grade and high school in Sacramento.

Mendenhall is a member of the Elks Lodge. He and his wife, Maude, have one son, a superintendent with a local heavy construction firm.

SLIDES CLOSE HIGHWAYS

In the Sierra Nevada, mud and rock slides closed the Emerald Bay section of State Sign Route 89 for 42 hours beginning the afternoon of December 15, and for more than 35 hours beginning the night of December 17. State Sign Routes 88 and 4 over Carson and Ebbetts Passes respectively were closed for the winter the first week of December.

Bridge Engineer G. L. Laird Retires

George L. Laird, supervising bridge engineer for the California Division of Highways, retired on October 1 after 24 years of state service.

For the past nine years, Laird has been assigned as bridge construction engineer (south) in charge of bridge construction in the four southern highway districts. During this period he has been responsible for the supervision of construction of well over $300,000,000 worth of highway structures.



G. L. LAIRD

Laird was born in Wisconsin but moved at an early age with his family to Oregon where where attended elementary and high schools. He is a graduate of Oregon State University, where he received his BS degree in 1924.

In 1925, after a brief period as assistant to the city engineer in Bandon, Oregon, Laird moved to Southern California and went to work for the City of Los Angeles.

Laird left the city in 1932 and joined the staff of the E. F. Knapp Construction Company as a project engineer. Among the many projects completed under his supervision were the Sixth Street Viaduct in Los Angeles, the Mt. Vernon Viaduct in San Bernardino, the Tuolumne River Bridge at Modesto and the approach structures to the San Francisco Bay Bridge.

Laird began his career with the Division of Highways in 1938, and his first assignment was as resident engineer on the Alhambra Overhead in the City of Los Angeles. During the next 12 years he was resident engineer on major bridge projects of increasing complexity throughout Southern California. In 1950 he was promoted to senior bridge engineer and in 1953 to supervising bridge engineer assigned as bridge construction engineer (south), a position he held until his retirement.

Planning Survey Engineer Retires

Frank M. Reynolds, who has been in charge of long-range California highway planning studies requested by the State Legislature for the last 11 years, retired on November 1 after 29 years with the State Division of Highways.



FRANK REYNOLDS

As principal highway engineer heading the California highway planning survey unit of the division, Reynolds was responsible for coordinating such major studies as the freeway system report of 1958, the city-county road needs of 1960 and the current scenic highways study.

His responsibilities also included supervision of numerous special highway routing reports requested by the Legislature; the statewide county road inventory of 1955; motor vehicle use studies in several major California cities, culminating in the current Los Angeles regional transportation study; and the division's extensive machine tabulation and electronic data processing system used in many aspects of state highway planning and operations.

Succeeding Reynolds in charge of the planning survey work will be C. G. Beer, who was appointed last July to the newly established position of urban planner for the Division of Highways.

Reynolds' wife, Frances, who has been an employee of the Division of Highways for the past 19 years and is currently secretary to State Highway Engineer J. C. Womack, will also leave state service on November 1.

Reynolds was born near Spokane, Washington, and attended school there. He served in the U.S. Army in World War I, then studied engineering at Washington State College at Pullman.

From 1922 to 1928 he worked on highway projects in the Northwest for the Washington State Highway Department and the U.S. Bureau of Public Roads.

In 1929 he moved to California and for the next seven years worked on highway location and construction in the San Joaquin Valley area. He was resident engineer on a 12-mile construction project on the Grapevine Grade on U.S. 99 during this period.

Reynolds was transferred to division headquarters in Sacramento in 1936. In 1940 he was appointed district traffic engineer at San Francisco, and the following year returned to Sacramento as assistant to the state traffic and safety engineer.

In 1942 he became highway engineer for the U.S. military mission in Iraq and Iran, with responsibility for developing a supply route between the Persian Gulf and Russia. Later he served as captain, then as major in the Army Engineers and later the Transportation Corps, with duty in both Washington, D.C., and Europe.

He returned to Division of Highways Headquarters in 1945 as assistant planning engineer. In 1951 he was promoted to his present position.

The Reynolds have two sons and a daughter.

James B. Woodson

James B. Woodson, who spent 29 years with the Division of Highways, first as a district engineer in District VI, and later as right-of-way agent in three other districts, died November 21. He was 83 years of age.

From 1933 until his retirement in 1945, Woodson had been right-of-way agent in charge of District IV.

His state career began in 1912 as division (district) engineer in District VI. He left the division in 1926 to enter private engineering practice in Los Angeles. In 1930 he re-entered state employment as right-of-way agent in District IX.

Woodson was born in Columbia, Missouri. Following his education at the University Academy in Columbia and at the University of Minnesota, he engaged in engineering in Washington, Colorado, Mexico and California for 10 years. He was a member of the American Society of Civil Engineers.

At the time of his death he resided at the Hotel Cecil in San Francisco.

Information Clerk Dean Snedden Retires

Mrs. Hazeldean Snedden, who in 18 years has served countless persons at the second floor information desk of the Public Works Building, retired November 30, after 20 years of service with the personnel section of the Division of Highways.



HAZELDEAN SNEDDEN

Having begun as junior clerk on a temporary basis in January 1943, she in turn worked up to the intermediate classification, and then to senior information clerk. During this time she has held preliminary interviews with thousands of job applicants, and answered the widely diversified questions of employees and visitors alike.

Born in Gladstone, Michigan, she spent her childhood and received her education in Manitoba, Canada. As a primary school teacher, she taught in Manitoba, Minnesota, Wyoming, and Nevada, before coming to California in 1926, when she began work with a San Francisco travel bureau. She came to Sacramento in 1933, where she married A. F. Snedden, a commercial agent for the Denver & Rio Grande Railroad, who died in 1942.

Mrs. Snedden is a member of the Moccasin Flower Chapter of Eastern Star in Mahomen, Minnesota, and has also been associated with other chapters. She is also a member of Kilwinning Lodge, the local chapter of Daughters of Scotia.

A daughter, Mrs. R. J. Hackbarth, also lives in Sacramento; and a son, Tom W. Snedden, lives in San Leandro. Mrs. Snedden also has two grandchildren and two great grandchildren.

Index to California Highways and Public Works

JANUARY TO DECEMBER 1962

SUBJECT INDEX

	Issue	Page
AASHO Road Test Report Discussed	Mar. - Apr.	22
Access Control, Freeway Expressway	July - Aug.	11
Accidents, Fewer Accidents Recorded On Cordelia-Fairfield-Vacaville-Vallejo-Benicia-Martinez-Crockett-Richmond-Berkeley-Oakland-San Leandro-Hayward-Fremont-Newark-Alameda-San Francisco-Daly City-Colma-San Bruno-San Mateo-Burlingame-Millbrae-San Francisco Airport-South San Francisco-San Bruno-Millbrae-Burlingame-San Mateo-Hayward-San Leandro-Oakland-Alameda-Berkeley-Richmond-Crockett-Martinez-Benicia-Vallejo-Vacaville-Fairfield-Cordelia-Suisun-Fairfield-Vacaville-Dixon-Davis-Woodland-Knights Landing-Yolo-Sacramento-Elk Grove-Galt-Lodi-Stockton-Manteca-Ripon-Escalon-Modesto-Turlock-Merced-Atwater-Livingston-Chowchilla-Madera-Fresno-Selma-Kingsburg-Reedley-Sanger-Fresno-Clovis

	Issue	Page
Sacramento County		
South Sacramento Freeway	Jan. - Feb.	16
Final Route Link—3½-mile West-side Freeway Now Located	July - Aug.	33
San Bernardino County		
San Gorgonio Pass—New $5,500,-000 Freeway Ends Traffic Problem	Jan. - Feb.	13
Redlands Freeway—New $16,-000,000 Project Serves Local, Interstate Traffic	Sept. - Oct.	7
San Diego County		
Moonlight Ride—San Diego's 'Crosstown' is Freeway with View (Reprint from San Diego Union)	July - Aug.	19
San Francisco County		
Bay Area Report	May - June	10
San Mateo County		
Bay Area Report	May - June	10
Junipero Serra—Advance Planning Pays off on Interstate Route 280	Jan. - Feb.	19
Santa Barbara County		
Goleta Project—Last Two-lane U.S. 101 Section in South Santa Barbara County is Eliminated	May - June	34
Santa Clara County		
Bay Area Report	May - June	10
Santa Cruz County		
Bay Area Report	May - June	10
Shasta County		
Sacramento River Bridge in Redding Widened	Jan. - Feb.	15
Whiskey Creek—Two-lane Structure Built to Provide for Future Widening	Mar. - Apr.	33
Feather Lake Highway Project is Example of Two Counties' Foresight	Jan. - Feb.	33
Solano County		
Vallejo-Benicia—First Section Completed on Connecting Freeway	Jan. - Feb.	29
Sonoma County		
Bay Area Report	May - June	10
Petaluma Bypass—Effect on Specific Businesses and the Community is Analyzed	July - Aug.	37
Stanislaus County		
New Intersection—FAS Project near Modesto	May - June	7
Ventura County		
Ventura County Freeways	Sept. - Oct.	36
L. A. Area Freeways—Report from District VII	Mar. - Apr.	42
Yolo County		
Yolo Causeway—New Crossing is Scheduled for Early 1963 Completion	May - June	44
"Great Yolo Basin Concrete Trestle" Completed March, 1916 (Condensed from earlier articles)	May - June	44
I.T.T.E., 14th Meet	Mar. - Apr.	64
Intersection, New—FAS Project Near Modesto	May - June	7
Jackson, Calvin—Letter Cites Foreman's Fast Thinking	May - June	63
Jonas, Paul—Hewes Award—Bridge Dep't's Sunbury, Lab's Jonas are 1962 Winners	July - Aug.	8
Jorgenson, J. F., Promoted to Construction Engineer	Sept. - Oct.	59
Junipero Serra—Illustrated Booklet Explains Roadwork	July - Aug.	44
Junipero Serra—Advance Planning Pays Off on Interstate Route 280	Jan. - Feb.	19
Last Ferry—Benicia-Martinez Service Ends After Opening of New Toll Bridge	Sept. - Oct.	5
Ledden, Charles T., and C. G. Beer Named to New Posts	July - Aug.	36
Legarra, J. A., Promoted to Deputy State Highway Engineer	Jan. - Feb.	60
Lights, Tunnel—New Fluorescent Lamp Fixtures are Brighter, Vandal-resistant	May - June	39
Los Angeles		
L. A. Area Freeways (Report from District VII)	Mar. - Apr.	42
Traffic Relief—Loop Freeways Ease Congestion in Metropolitan Los Angeles	Sept. - Oct.	16
MacArthur Freeway	July - Aug.	2
Maintenance		
New Maintenance Man Classes	Jan. - Feb.	69
Maintenance Engineers Meet in Sacramento	Jan. - Feb.	68
Modesto		
New Intersection—FAS Project Near Modesto	May - June	7
Tests—Cable-chain Rigid Beam Barriers Given Further Lab, Field Study	Mar. - Apr.	16
Motor Vehicle Study, State Launches	July - Aug.	36
Moonlight Ride—San Diego 'Crosstown' is Freeway with View (Reprint from San Diego Union)	July - Aug.	19
National Highway Week, May 20-26	May - June	Inside Back Cover
Highway Week Set for May 20-26	Mar. - Apr.	68
National Safety Council		
Traffic Engineering Award Presented to Division (National Safety Council Certificate for 1961)	July - Aug.	20
New Intersection—FAS Project Near Modesto	May - June	7
Obituaries		
In Memoriam	Mar. - Apr.	32
	May - June	62
	July - Aug.	54
	Sept. - Oct.	63
Cortelyou, Spencer V.	Sept. - Oct.	46
Harris, Milton	Sept. - Oct.	61
Kennedy, R. C.	Jan. - Feb.	79
Lamb, G. H.	May - June	60
Martin, James E.	May - June	58
Stanton, T. E.	May - June	61
West, M. H.	May - June	63
Paint, Experimental—Corrosion Resistance Tested on Leffingwell Creek Bridge	Jan. - Feb.	26
Paving Methods		
Central Mix—Revised Method Speeds Road Paving Operations	July - Aug.	29
Paving, Slip-form		
Goleta Project—Last Two-lane U.S. 101 Section in South Santa Barbara County is Eliminated	May - June	34
Slip-form Job—Fresno—Variation of Previous Techniques Described	Sept. - Oct.	24
Slip-form Paver Used on San Gorgonio Pass Job	Jan. - Feb.	14
Payne, Franklin, Named to Highway Commission	Jan. - Feb.	2
Petaluma Bypass—Effect on Specific Businesses and Community Analyzed	July - Aug.	37
Policy on Scenic Values	July - Aug.	Inside Front Cover
Potter, R. V., Named to Systems Research Engineer	Sept. - Oct.	59
Processes, New		
Reduced Plans—Up-to-date Processes Realize Large Savings	July - Aug.	45
Railings, Kidproof,—Safety Offers Challenges on Pedestrian Crossings	Sept. - Oct.	19
Randolph Collier Tunnel		
Progress Reported on Bridge Projects	May - June	33
Record Sampling Highway Testing Program Checks Structural Sections	Mar. - Apr.	58
Redlands Freeway—New $16,000,000 Project Serves Local, Interstate Traffic	Sept. - Oct.	7
Reduced Plans—Up-to-date Processes Realize Large Savings	July - Aug.	45
Redwood Freeway—7½-mile Section Offers Convenience, New Vistas	Jan. - Feb.	3
Reports		
Bay Area Report	May - June	10
L. A. Area Freeways	Mar. - Apr.	42
Research		
National Cooperative Research Program Initiated	July - Aug.	20
Route Adoptions	Jan. - Feb.	66
	Mar. - Apr.	71
	May - June	32
Route Adoptions—New Exceed Half of State Freeway System (6,240 miles)	Sept. - Oct.	49
Retirements Listed, Recent	Mar. - Apr.	74
	May - June	61
	July - Aug.	53
	Sept. - Oct.	61
Bangert, Nelson R.	Sept. - Oct.	62
Barry, George	Sept. - Oct.	62
Belford, H. E.	Mar. - Apr.	77
Bock, William	Jan. - Feb.	35
Boyd, Anson	Mar. - Apr.	72
Briney, A. C.	July - Aug.	54
Burns, C. R.	Mar. - Apr.	78
Cardwell, M. L.	May - June	33
Chase, R. V.	Jan. - Feb.	25
Cook, George N.	Mar. - Apr.	73
Crane, Leland T.	Sept. - Oct.	63
Creed, J. H.	May - June	31
Davis, Coral	Jan. - Feb.	79
Forschler, Homer T.	July - Aug.	54
Garrison, F. R.	Mar. - Apr.	77
Green, Frank F.	July - Aug.	54
Halsted, Helen	July - Aug.	18
Havlik, Stanley	Mar. - Apr.	79
Hawthorne, Henry	Mar. - Apr.	77
Higgins, E. Roy	Mar. - Apr.	69
Hilton, Albert A.	July - Aug.	55
Keating, Albert	Mar. - Apr.	79
LaForge, H. B.	Mar. - Apr.	29
Manhart, Forrest R.	Mar. - Apr.	78
Morgan, John	Mar. - Apr.	79
Nash, A. M.	Sept. - Oct.	59
Nelson, M. F. "Mique"	Sept. - Oct.	59
Ramsey, Richard H	July - Aug.	55
Redden, L. R.	Jan. - Feb.	62
Remington, W. G.	Mar. - Apr.	5
Reynolds, Thomas W.	May - June	60
Root, A. W.	May - June	58
Rose, Cass M.	July - Aug.	52
Sullivan, Mae	Mar. - Apr.	79
Trask, J. W.	Jan. - Feb.	60
Tremper, Bailey	Mar. - Apr.	78
Van Dalsem, Burnell	Sept. - Oct.	60
Whitlock, Harold J.	Mar. - Apr.	77
Wood, Howard C.	Mar. - Apr.	73
Safety		
Freeway Accidents—No Cross Traffic Keeps Rate Low	Mar. - Apr.	9
Kidproof Railings—Safety Offers Challenge on Pedestrian Crossings	Sept. - Oct.	19
Traffic Safety Governor's Conference Draws 1,200 Delegates	Mar. - Apr.	28
San Diego-Coronado Bridge	Sept. - Oct.	58
San Diego-Coronado Highway Toll Crossing, Hearing Held on	May - June	62
San Diego Freeway		
Cable Moving New 'Skidding' Technique Saves State $146,000	Jan. - Feb.	44
Half of 90-mile Route Completed or Under Way	Jan. - Feb.	45
San Francisco-Oakland Bay Bridge		
Progress Reported on Bridge Projects	May - June	33
San Gabriel River Bridge, Span Lift Used to Raise	May - June	59
San Gorgonio Pass—New $5,500,000 Freeway Ends Traffic Problem	Jan. - Feb.	13
San Mateo-Hayward Bridge Design is Approved	Jan. - Feb.	61
San Pedro-Terminal Island Toll Bridge		
Progress Reported on Bridge Projects	May - June	33
Santa Monica Freeway		
Traffic Relief—Loop Freeways Ease Congestion in Metropolitan Los Angeles	Sept. - Oct.	16
Scenic Highways		
Advisors on Scenic Highways Study Conference (Picture)	Jan. - Feb.	Inside Front Cover
Policy on Scenic Values	July - Aug.	Inside Front Cover
Scenic Routes—Report to Legislature Urges Protection of 'Corridor' Vistas	Mar. - Apr.	2
Signs and Signals		
Conference Promotes Uniform Signs, Signals	Mar. - Apr.	23
"Now and Then"—Largest Highway Sign Ever Erected in California	Jan. - Feb.	Inside Back Cover
Sign Changes—Revised Manual	Mar. - Apr.	26
Slip-form Paving		
Gillis, Spickelmire Write ARBA Bulletin	Sept. - Oct.	60
Redlands Freeway—New $16,000,-000 Project Serves Local, Interstate Traffic	Sept. - Oct.	7
San Gorgonio Pass—New $5,500,000 Freeway Ends Traffic Problem	Jan. - Feb.	13
Slip-form Job—Fresno—Variation of Previous Techniques Described	Sept. - Oct.	24
Snow Removal		
Snow! Snow! Snow! (National Guard)	Mar. - Apr.	40
Snow in the South	Mar. - Apr.	37
South Sacramento Freeway	Jan. - Feb.	16
Span Lift—Novel Method Used to Raise San Gabriel River Bridge	May - June	59
Spickelmire, Gillis Write ARBA Bulletin	Sept. - Oct.	60
Sunbury, Roger D.—Hewes Award—Bridge Dept's. Sunbury, Lab's Jonas are 1962 Winners	July - Aug.	8
Survey Party, 1911, on El Camino Real	July - Aug.	Inside Back Cover
Surveys		
Meet the Geodimeter	May - June	50
Sweet, C. L., Appointed Bridge Engineer, State-owned Toll Bridges, to Succeed Howard Wood	Mar. - Apr.	73
Telford, Edward T., Promoted to Metropolitan District Engineer	July - Aug.	35
Terminal Island—San Pedro Toll Bridge Progress Reported on Bridge Projects	May - June	33
Test Track		
AASHO Road Tests to be Discussed at Conference	Mar. - Apr.	22
Tests		
More Tests—Cable-chain, Rigid Beam Barriers Given Further Lab, Field Study	Mar. - Apr.	16
Record Sampling—Highway Testing Program Checks Structural Sections	Mar. - Apr.	58

	Issue	Page
Tinney, E. L., Promoted to Maintenance Engineer	Jan. - Feb.	61
Traffic Congestion		
Traffic Relief: Loop Freeways Ease Congestion in Metropolitan Los Angeles	Sept. - Oct.	16
Traffic Counts, Surveys		
Traffic Census—Self-recording Equipment Replaces Manual Counting	July - Aug.	21
Traffic Engineering Award Presented to Division	July - Aug.	20
Traffic Safety Governor's Conference Draws 1,200 Delegates	Mar. - Apr.	28
Traffic Striping		
Traffic Striper—New Machine Has Flexibility and Ease in Control	July - Aug.	31
Traffic Stripes—New Thermoplastic Applicator Proves Worth in Heavy Use Areas	Sept. - Oct.	47
Training, On-job		
New Maintenance Man Classes	Jan. - Feb.	69
Tunnel Lights—New Fluorescent Lamp Fixtures are Brighter, Vandal-resistant	May - June	50
Two-county Link: Divided Highway Connects Katella Ave., Willow St.	Sept. - Oct.	28
Twolane Expressways	July - Aug.	11
U.S. 40—Sacramento to Nevada Section now has 99 Miles of Freeway and Expressway	Jan. - Feb.	8
Timber		
Cable Moving—New 'Skidding' Technique Saves State $146,000	Jan. - Feb.	44
Vallejo-Benicia—First Section Completed on Connecting Freeway	Jan. - Feb.	29
Vietnam Highways—A California Engineer Goes to Southeast Asia	Jan. - Feb.	70
Webster Street Tube		
Progress Reported on Bridge Projects	May - June	33
West Branch Bridge—Feather River Relocation Ready	May - June	2
Westside Freeway		
Final Route Link—316-mile Westside Freeway now Located	July - Aug.	33
Yolo Causeway—New Crossing Scheduled for Early 1963 Completion	May - June	44
"Great Yolo Basin Concrete Trestle" Was Completed in March, 1916 (Condensed from earlier articles)	May - June	44

AUTHOR INDEX

	Issue	Page
Alderman, Roy—Goleta Project—Last Two-Lane U.S. 101 Section in South Santa Barbara County is Eliminated	May - June	34
Beaton, John L.—More Tests—Cable-chain, Rigid Beam Barriers Given Further Lab, Field Study (Co-au.)	Mar. - Apr.	16
Benedict, H. W.—Redwood Freeway—7½-mile Section Offers Convenience, New Vistas	Jan. - Feb.	3
Bottorff, R. D.—Onion Valley—Inyo County's New F.A.S. Road Opens High Sierra to Motorists	Mar. - Apr.	30
Bruch, Harter R.—New Intersection—Stanislaus County Constructs F.A.S. Project Near Modesto	May - June	7
Chamberlain, Donald D.—Feather Lake—Highway Project is Example of Two Counties' Foresight	Jan. - Feb.	33
Chan, Wah G.—Flood Problems—3; Cooperative Drainage Job Features Earth Fill Dam (Co-au.)	Jan. - Feb.	63
Chapman, M.—Yolo Causeway—New Crossing Scheduled for Early 1963 Completion (Co-au.)	May - June	44
Choi, Harry—Reduced Plan—Up-to-date Processes Realize Large Savings	July - Aug.	45
Colley, R. F.—Yolo Causeway—New Crossing Scheduled for Early 1963 Completion (Co-au.)	May - June	44
Collins, J. D.—MacArthur Freeway (Co-au.)	July - Aug.	2
Crawford, W. H.—Redlands Freeway—New $16,000,000 Project Serves Local, Interstate Traffic	Sept. - Oct.	7
Currier, David E.—Extra Lanes—Passing, Chain Control Areas on U.S. 50 Prove Their Worth	Mar. - Apr.	61
Decker, Ralph E.—Cable Moving—New 'Skidding' Treatment Saves State $146,000 (Co-au.)	Jan. - Feb.	44
Dillon, G. E.—Fewer Accidents—Richmond-Carquinez U.S. 40 Study Shows Three-Year Drop	Mar. - Apr.	23
Dunham, Carroll F.—Self-Recording Equipment Replaces Manual Counting (Co-au.)	July - Aug.	21
Elliott, Arthur L.—Kidproof Railings—Safety Offers Challenge on Pedestrian Crossings	Sept. - Oct.	19
Field, Robert N.—More Tests—Cable-chain, Rigid Beam Barriers Given Further Lab, Field Study (Co-au.)	Mar. - Apr.	16
Gillis, Lyman R.—Record Sampling—Highway Testing Program Checks Structural Sections	Mar. - Apr.	58
Grasberger, Jack O.—Junipero Serra—Advance Planning Pays Off on Interstate Route 280	Jan. - Feb.	19
Gray, George E.—Vietnam Highways	Jan. - Feb.	70
Hammond, Rufus M.—Evaporation Rate—Apparatus Measures Water Loss During Construction Operations	July - Aug.	49
Hampton, James H.—Petaluma By-pass—Effect on Specific Businesses and the Community is Analyzed. (A Report of the Land Economic Studies Section, Right of Way Dept.)	July - Aug.	37
Harris, P. C.—West Branch Bridge—Feather River Relocation Ready	May - June	2
Hart, Alan S.—U.S. 40—Sacramento to Nevada Section Now Has 99 Miles of Freeway and Expressway	Jan. - Feb.	8
Heckeroth, Heinz—Traffic Relief—Loop Freeways Ease Congestion in Metropolitan Los Angeles	Sept. - Oct.	16
Hamerston, Nelson E.—Shotcrete Job—Fresno: Variation of Previous Techniques Described	Sept. - Oct.	24
Kapono, J. O.—Central Mix—Revised Method Speeds Road Paving Operations	July - Aug.	29
Katibah, George P.—Meet the Geodimeter, (Co-au.)	May - June	50
Kreiberg, T. N.—Tunnel Lights—New Fluorescent Lamp Fixtures are Brighter, Vandal-Resistant	May - June	50
Martin, James E.—San Diego Freeway—Half of 90-mile Route Completed or Under Way	Jan. - Feb.	45
Mauzy, H. K.—Bridge Costs—1961 Average is 6½ Percent Higher than Previous Year (Co-au.)	Mar. - Apr.	75
McGuigan, G. G.—Federal Aid '51 to '62	Sept. - Oct.	51
McIntosh, W. D.—Feather Lake—Highway Project is Example of Two Counties' Foresight	Jan. - Feb.	33
Moskowitz, Karl—Freeway Accidents—No Cross Traffic Keeps Rate Low	Mar. - Apr.	9
Muller, H. W.—Cable Moving—New 'Skidding' Technique Saves State $146,000 (Co-au.)	Jan. - Feb.	44
O'Malley, John—Snow in the South—Maintenance Crews Meet Unusual Challenge	Mar. - Apr.	37
Pettine, J. D.—Whiskey Creek—Two-lane Structure Built to Provide for Future Widening	Mar. - Apr.	33
Raab, Norman C.—Bay Bridge—Second Phase of Reconstruction Nearing Completion	Jan. - Feb.	36
Radmanovich, Dan—Meet the Geodimeter (Co-au.)	May - June	50
Remington, W. G.—Bayshore Freeway—San Jose to San Francisco is Now All Full Freeway	Mar. - Apr.	5
Roderick, C. F.—Vallejo-Benicia—First Section Completed on Connecting Freeway	Jan. - Feb.	29
Rooney, H. A.—Experimental Paint—Corrosion Resistance Tested on Leffingwell Creek Bridge	Jan. - Feb.	26
Ross, James W.—Flood Problems—3; Cooperative Drainage Job Features Earth Fill Dam	Jan. - Feb.	63
Silva, Edward F.—South Sacramento Freeway (Co-au.)	Jan. - Feb.	16
Sinclair, J. P.—Bay Area Report	May - June	10
Smith, G. C.—Span Lift—Novel Method Used to Raise San Gabriel River Bridge	May - June	54
Tamburri, Thomas N.—Traffic Census—Self Recording Equipment Replaces Manual Counting (Co-au.)	July - Aug.	21
Telford, E. T.—L. A. Area Freeways	Mar. - Apr.	42
Telford, E. T.—Ventura County Freeways	Sept. - Oct.	36
Templin, Newton H.—Two-County Link—Divided Highway Connects Katella Ave., Willow St.	Sept. - Oct.	28
Teuscher, J. J.—Last Ferry—Benicia-Martinez Service Ends After Opening of New Toll Bridge	Sept. - Oct.	2
Thomas, E. B.—Fortuna Project—New Freeway Relieves City's Traffic Congestion	Sept. - Oct.	31
Watson, J. B.—MacArthur Freeway (Co-au.)	July - Aug.	2
Webb, G. M.—Sign Changes—Revised Interstate Manual will be Published Soon	Mar. - Apr.	26
Woods, A. L.—Experimental Paint—Corrosion Resistance Tested on Leffingwell Creek Bridge (Co-au.)	Jan. - Feb.	26
Young, D. M.—South Sacramento Freeway (Co-au.)	Jan. - Feb.	16
Yusavage, W. J.—Bridge Costs—1961 Average is 6½ Percent Higher than Previous Year (Co-au.)	Mar. - Apr.	75

C.H.C. Authorizes 'Mission Bell' Funds

Expenditure of $19,000 for installation of mission bell replicas in conjunction with new "El Camino Real" signs at 81 locations along U.S. 101 between San Francisco and Los Angeles has been authorized by the California Highway Commission.

The bells are being furnished to the Division of Highways by the Committee for El Camino Real, comprising several interested organizations. They are similar to the bells which were formerly in place along U.S. 101 but which disappeared as the highway was converted to multilane freeway and expressway, frequently in a different location from the original route.

The Legislature, in 1959, authorized the Division of Highways to install the bells as furnished. The division plans to erect the bells near major junctions, at the entrances and exits of communities along the route, and at approximately 10-mile intervals on long open stretches.

State Highway Engineer J. C. Womack explained that no bells are being installed between Los Angeles and San Diego because that portion of U.S. 101 is on the national interstate highway system and federal rules prohibit nonregulation signs.

It will take a few months to install the bells in conjunction with the signs, Womack said.

The organizations sponsoring the mission bell effort include the California Mission Trails Association, the Native Sons and Native Daughters of the Golden West, the California Historical Society, and the Colonial Dames of the Seventeenth Century.

---

49 CONTRACTS COMPLETED

During December the Department of Public Works advertised for bids on 24 projects with an estimated value of $16,159,800, and awarded 31 contracts for $29,622,700. Contracts were completed for 49 projects at a cost of $21,151,800.

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

HIGHWAY TRANSPORTATION AGENCY

ROBERT B. BRADFORD . . . Administrator

DEPARTMENT OF PUBLIC WORKS . . . ROBERT B. BRADFORD, Director

FRANK A. CHAMBERS . . . . Chief Deputy Director

RUSSELL J. COONEY . . Deputy Director (Management)
HARRY D. FREEMAN . . Deputy Director (Planning)
T. F. BAGSHAW . . . . . Assistant Director
JOHN H. STANFORD . . . . . Assistant Director
JUSTIN DuCRAY . Departmental Management Analyst
S. ALAN WHITE . . Departmental Personnel Officer

DIVISION OF HIGHWAYS

J. C. WOMACK . . . State Highway Engineer, Chief of Division

CHAS. E. WAITE . . . Deputy State Highway Engineer
J. P. MURPHY . . . Deputy State Highway Engineer
J. A. LEGARRA . . Deputy State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
GEO. LANGSNER . . Assistant State Highway Engineer
FRANK E. BAXTER . Assistant State Highway Engineer
J. C. BURRILL . . . . . Comptroller
JOHN L. BEATON . . . . . Equipment Engineer
C. G. BEER . . . . . Urban Planner
L. L. FUNK . . . . . Planning Engineer
GEORGE A. HILL . . . . . Traffic Engineer
F. N. HVEEM . . . Materials and Research Engineer
J. F. JORGENSEN . . . . . Construction Engineer
SCOTT H. LATHROP . Personnel and Public Information
C. T. LEDDEN . . City and County Projects Engineer
H. C. McCARTY . . . . . Office Engineer
E. J. L. PETERSON . . Program and Budget Engineer
R. V. POTTER . . . . Systems Research Engineer
E. L. TINNEY . . . . . Maintenance Engineer
W. L. WARREN . . . . . Engineer of Design
G. M. WEBB . . . Traffic Engineer—Special Studies
A. L. ELLIOTT . . . . Bridge Engineer—Planning
L. C. HOLLISTER . Bridge Engineer—Special Projects
I. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area

Right-of-Way

RUDOLF HESS . . . . . Chief Right-of-Way Agent
DEXTER D. MacBRIDE . . . . . Assistant Chief
RAY E. O'BIER . . . . . Assistant Chief
R. S. J. PIANEZZI . . . . . Assistant Chief
JACQUES T. ZEEMAN . . . . . Assistant Chief

District I, Eureka

SAM HELWER . . . . . District Engineer

District II, Redding

H. S. MILES . . . . . District Engineer

District III, Marysville

ALAN S. HART . . Assistant State Highway Engineer

District IV, San Francisco

J. P. SINCLAIR . . Assistant State Highway Engineer
R. A. HAYLER . . . . . District Engineer
HAIG AYANIAN . . . . . District Engineer
C. F. GREENE . . . . . District Engineer

District V, San Luis Obispo

E. R. FOLEY . . . . . District Engineer

District VI, Fresno

W. L. WELCH . . . . . District Engineer

District VII, Los Angeles

E. T. TELFORD . . . Metropolitan District Engineer
A. L. HIMELHOCH . . . . . District Engineer
A. C. BIRNIE . . . . . District Engineer
A. W. HOY . . . . . District Engineer
R. E. Deffebach . . . . . District Engineer

CALIFORNIA HIGHWAY COMMISSION

ROBERT B. BRADFORD . Chairman and Director of Public Works
JAMES A. GUTHRIE . . Vice Chairman San Bernardino
ARTHUR T. LUDDY . . . Sacramento
ROGER S. WOOLLEY . . . San Diego
JOHN ERRECA . . . . . Los Banos
ABRAHAM KOFMAN . . . San Jose
FRANKLIN S. PAYNE . . Los Angeles
JACK COOPER, Secretary . . . Sacramento

District VIII, San Bernardino

C. V. KANE . . . . . District Enginee

District IX, Bishop

C. A. SHERVINGTON . . . . . District Enginee

District X, Stockton

JOHN G. MEYER . . . . . District Enginee

District XI, San Diego

JACOB DEKEMA . . Assistant State Highway Enginee

State-owned Toll Bridges

CHARLES L. SWEET . . . . . Bridge Enginee

DIVISION OF CONTRACTS AND RIGHTS-OF-WAY (LEGAL)

ROBERT E. REED . . . . . Chief Counsel

GEORGE C. HADLEY . . . . . Assistant Chief
HOLLOWAY JONES . . . . . Assistant Chief
HARRY S. FENTON . . . . . Assistant Chie

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

NORMAN C. RAAB . . . . Chief of Division
BEN BALALA . . . . . Principal Bridge Engineer

DIVISION OF ARCHITECTURE

EARL W. HAMPTON . . . Acting State Architect, Chief of Division

EARL W. HAMPTON . . . . . Deputy Chief, Architecture and Engineering
HUBERT S. HUNTER . . . . . Deputy Chief, Administrative
ARTHUR F. DUDMAN . . . . . Assistant State Architect (North
TOM MERET . . . . . Assistant State Architect (South
CHARLES M. HERD . . . . . Chief Construction Engineer

DIVISION OF AERONAUTICS

CLYDE P. BARNETT . . . . . Director, Chief of Division

78026 2-63 52,100

printed in CALIFORNIA STATE PRINTING OFFIC

The Drinking Driver and Traffic Accidents

CHP Commissioner Comments on the Problem

January 30, 1963

W. Clifford Harvey
Automobile Editor
The Christian Science Monitor
One Norway Street
Boston 15, Massachusetts

Dear Mr. Harvey: At Mr. Womack's request, I am replying to your letter to him as State Highway Engineer in which you posed several questions regarding the role of the drinking driver in traffic accidents in California.

Inasmuch as our tabulation of 1962 statistics is not complete I will use 1961 figures in commenting upon California's experience. Our records for 1961 (and the figures do not change much from year to year) show that 20.7 percent of all fatal and injury accidents in California involved the "had been drinking" factor. Fatal and injury accidents that year totalled 108,999, of which 22,568 involved drinking. It is possible, as you said, that this figure might be higher if the liquor factor could be more easily detected.

I certainly concur with the thought that the average drinking driver thinks his ability to drive safely has not been affected.

California law enforcement agencies, in my opinion, recognize their responsibility in this problem. We attempt to meet it with vigorous enforcement and continuing educational activity.

I cannot agree that in California we charge accidents to other violations when, in fact, drinking is the underlying cause. In our investigation of accidents we state the violation that was the proximate cause and record, in addition, whether the driver or drivers involved had been drinking. Of course, if a driver is deemed by the investigating officer to be under the influence of alcohol this is recorded as the primary cause of the accident. Of the 2,813 drivers deemed to have violated the Vehicle Code and thus caused a fatal accident, 122 were charged with being under the influence of alcohol. Speeding violations were charged in 1,251 fatal accidents.

I do not believe that the drinking driver problem is generally out of hand. Neither do I believe we are very near to its solution. As long as drinking of alcoholic beverages is an accepted social behavior we will continue to have the problem of the drinking driver. I see no prospect of the American people adopting a different attitude toward drinking, but I hope some day they will demand that the person who takes a life or causes serious injury because he was involved in an accident while under the influence of alcohol pay a penalty that is appropriate to the crime.

Cordially,

Bradford M. Crittenden
Commissioner
California Highway Patrol

alifornia Highways and Public Works
DIVISION OF HIGHWAYS
P O Box 1499
ACRAMENTO, CALIFORNIA

RETURN REQUESTED

SEATTLE PUBLIC LIBRARY
4TH & MADISON
SEATTLE 4, WASHINGTON

R56

BULK RATE
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152



Seattle Public Library
MAY 28 1963

CALIFORNIA Highways and Public Works

TECHNOLOGY
FILE IN STACKS



MARCH-APRIL
1963



The Ventura Freeway in the City of Ventura. The view is westerly, with the Ojai Freeway interchange top left. *(See "District VII Freeways" beginning page 20.)*

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

Vol. 42 March-April Nos. 3-4



ONT COVER: *Because it is spring and once again the wild-wers are blooming in California, this month's cover pays homage that part of the State which is famous for its displays of color this time of the year. Our cover patch of wildflowers was nd by Division of Highways photographer John Meyerpeter, he Kern County foothills near the Arvin turnoff on U.S. 466.*

CK COVER: *Traffic flows freely and happily over the new sec- of the San Diego Freeway across Sepulveda Pass in Los An-es County. Bridge in center carries Mulholland Drive. Small o of old route is seen at extreme left, about 2½ inches up n bottom of photo. Aerial photography by Robert Dunn. (See trict VII Freeways," page 20.)*



CONTENTS

	Page
U.S. 40 Progress in Sierra By Alan S. Hart, Assistant State Highway Engineer	2
Scenic Highways	8
Webster St. Tube By W. C. Names, Resident Engineer, and William F. Wolfson, Assistant Resident Engineer	10
Conway Grade By Gene J. Snyder, Resident Engineer	16
District VII Freeways By Edward T. Telford, Metropolitan District Engineer	20
Governor Appoints Erreca As Public Works Head	42
Urban Planning	43
Pacheco Pass By Louis G. Kroeck, District Design Engineer	45
Mojave River Bridge By R. W. Austin, Project Engineer	50
Sign Route 1 By James M. Sturgeon, District Construction Engineer	51
Contraction Joints	56
Freeway Guardrail By Roger T. Johnson and Thomas N. Tamburri, Assistant Traffic Engineers	58
Solano Avenue By James L. Martin, Director of Public Works, City of Berkeley	61
Santa Rosa North By V. S. Yoder and Harold W. Keeler, Jr., Resident Engineers	65
Road Conference	69
83-mile Route	71
Bridge Costs By H. K. Mauzy, Senior Bridge Engineer, and W. J. Yusavage, Associate Research Technician	73
Twentynine Palms Interchange By J. E. Walsh, Project Engineer	75
Sierra Sam	76
H.R. 381 Study Groups Hold Region Meetings	77
Twenty-five-year List	78
New Transbay Study Shows Bridge Need	78

Retirements

George M. Webb	68	Recent Retirements	79
Charles M. Herd	74	C. H. Hixson	79
Frank B. Cressy	77		

In Memoriam 42

LESTER S. KORITZ, *Editor*

STEWART MITCHELL, *Associate Editor* JOHN C. ROBINSON, *Associate Editor*

WILLIAM R. CHANEY, *Chief Photographer*

Editors are invited to use information contained herein and to request prints of any black and white photographs.

Address communications to: EDITOR,

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

P. O. Box 1499

SACRAMENTO, CALIFORNIA

U.S. 40 Progress in Sierra

By ALAN S. HART, Assistant State Highway Engineer



The spectacular job of converting the high Sierra portion of U.S. 40 to an interstate freeway—Interstate 80—has entered its final phases and the new facility is expected to be ready for traffic by the end of 1964.

A brief look at the entire 120-mile route between Sacramento and the Nevada state line shows that approximately 100 miles are now four or more lanes, and all, except for about 14 miles northeast of Auburn, are full freeway. That expressway section requires about a dozen structures and interchanges to eliminate intersections at grade.

Special Cold Weather Mix

The entire mountain section from Colfax to the state line is or will be paved with portland cement concrete. A six-sack mix containing an air-entrainment agent was employed due to freezing winter temperatures and the extensive use of salt to control icy pavements and early clearing of snow pack.

Although no additional projects have been completed since our last report in the January-February 1962 issue of this magazine, work is well underway on the two remaining stretches in the upper Sierra Nevada range.

One is between Emigrant Gap and Hampshire Rocks and the other is over Donner Summit.

The 11½-mile Emigrant Gap to Hampshire Rocks section is being built under two contracts. The 5.4 miles from Emigrant Gap to the junction of State Sign Route 20 was started in July 1961 under an $8,000,000 contract with Guy F. Atkinson Company of South San Francisco. It is currently about 65 percent complete and is expected to be finished by the end of 1963.

Hundred Working Days Annually

Reason for the seemingly long elapsed time required for construction is that contractors can count on only about 100 working days per year in the high snow country. Most operations are limited to June through October or November. Elevation ranges from 5,300 to 7,200 feet.

The 1962 season's work on this job included paving a 2½-mile piece of the future westbound lanes to the east of Emigrant Gap. Two-way traffic is now being routed over this completed section. Portions of the old road will be reconstructed and become the new eastbound lanes.

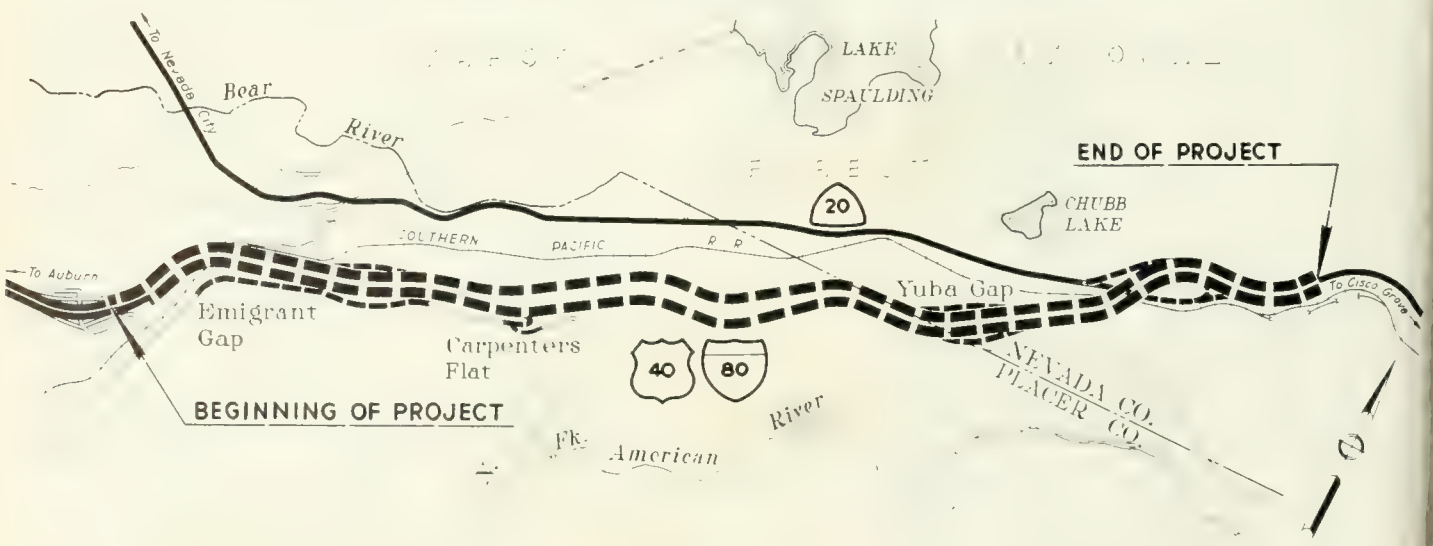
As with the other high Sierra freeway projects, this one will feature what is actually two separate roadways. Opposing lanes will be built on independent vertical and horizontal alignments with widely varying median widths to conform to the terrain and to provide adequate room for snow throw.

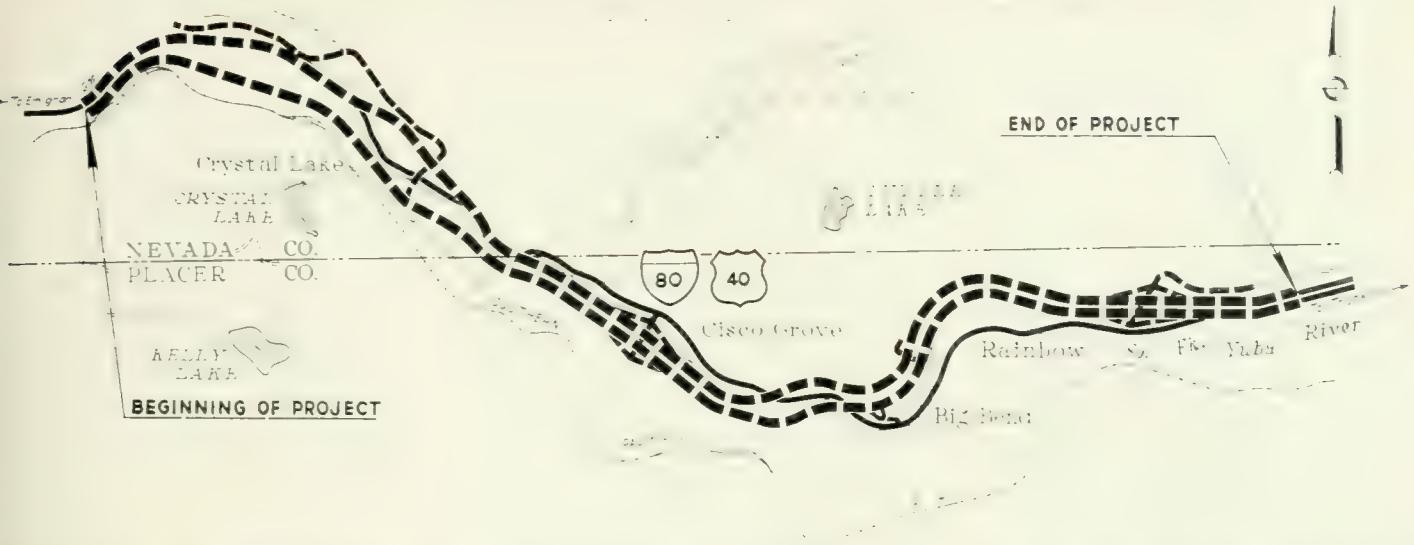
Narrow Hogback

Trickiest from the design and construction engineering angle was the area in the vicinity of Emigrant Gap where the freeway and a double-track railroad necessarily cross each other on a narrow hogback ridge.

Compounding problems in this extremely limited space was the fact that underground transcontinental

General alignment of the Emigrant Gap-SSR 20 project is shown by heavy dashed lines. Narrower dashed lines indicate frontage roads and interchanges to be constructed. Observation point will be located on north side of freeway near Emigrant Gap.





eavy broken line shows general alignment of the SSR 20-Hampshire Rocks project. Narrow broken line shows access roads to recreational areas and inter-hanges. Solid line is existing highway, most of which will be preserved as frontage road. Frontage road and South Fork Yuba River run down median at two locations. Hampshire Rocks Campground is located near east end of project.

tility lines must also occupy part of he ridge. Extensive planning, design, iming, and liaison were required to ovetail construction phases without nterrupting highway, rail, or utility raffic. During this time the affected ompanies co-operated fully with the ontractor and resident engineer.

Ordinarily in this heavy snow re-ion a minimum median of 100 feet employed to give plenty of room r disposal of snow. In this section e 10-foot asphalt-paved shoulders on th inside and outside will serve to re snow windrowed by push plows ntil the rotaries can move in and toss clear.

Interchanges for local traffic and cess to adjacent recreational areas e being built at Carpenter's Flat, uba Gap, and at the SSR 20 junction. ear Emigrant Gap an observation nt and parking area will be pro-ied for a leisurely view of the Bear lley and Lake Spaulding north of freeway.

Roadway excavation for this job l run an estimated 2,500,000 cubic ds—much of it granite with some ccia, and most of it being handled h scrapers and power shovels.

Cisco Grove—Hampshire Rocks

n the 6.3 miles from the SSR 20 tion through Cisco Grove to mpshire Rocks, work started in

Below. Aerial, looking easterly, with site of future State Sign Route 20 interchange upper center. SSR 20 is ribbon farthest left. Southern Pacific tracks are a little farther up the ridge. Just over the right side of the ridge will be future westbound lanes, and farther to the right is the existing highway which will be reconstructed into eastbound freeway lanes.





ABOVE. Old section of U.S. 40 still in use at Soda Springs is congested with weekend ski traffic. With summit realignment old section will be retained for recreational use, and new summit route will allow free flow of traffic as this completed split-level section below Norden now does (below).



late June of 1962 under an $11,000,000 contract with the joint venture firm of Fredrickson & Watson and Granite Construction Company of Oakland. It is the largest contract ever awarded in District III, the Emigrant Gap-SSR 20 job having been the previous high.

Work is about 38 percent complete and should be finished by the end of 1964. However, it could run into 1965 depending on weather or unusual circumstances.

This project is a monumental undertaking with an estimated 2,225,000 cubic yards of roadway excavation through predominantly solid granite and other type hard rock requiring drilling, blasting, and removal by shovel.

Median width between the completely independent roadways will vary up to 1,000 feet at one point in the Yuba River canyon. In this area are places where unique conditions provide that not only will the river flow between opposing lanes, but the frontage road and even private property will be within the median.

To provide access to residental and recreational areas, interchanges will be located at Indian Springs Road, Cisco Grove, and Hampshire Rocks. In addition, five bridges across the Yuba River are required due to the alignment being confined to the canyon proper.

A major portion of the existing two-lane conventional highway will be preserved for access to summer homes and the year-round recreation facilities along the route.

Donner Summit Section

The most dramatic project of all is the new 10½-mile crossing of Donner Summit. Linking completed freeways at Soda Springs and the east end of Donner Lake, this massive job has been divided into three separate units adding up to a construction cost of some $15,000,000.

The first two were for grading and structures on the new alignment which will swing as much as 1½ miles to the north of the existing summit highway. Work on the west slope approaching the 7,239-foot pass was finished in October 1962 at a cost of $2,400,000 by the Atkinson firm. (The



Self-propelled pneumatic drills here shown in operation have been used in dozens of places on summit jobs to build road through sheer granite.



Looking west from point above outskirts of Truckee, view along contract east of summit. Old route passes close to shore of Donner Lake in center of photo, then climbs cliff face distant center over Donner Pass. New summit is visible as light spot upper right. Section in left foreground is already completed.

One of five shovel-and-haul operations last summer on east slope of Donner Summit relocation. Huge trucks do not seem large, but each carries 38 tons.



present summit road peaks at 7,135 feet.)

Grading and structure work on the eastern side is about 95 percent complete and after being resumed this spring should wind up by September. Operating on a $7,400,000 contract, the prime contractor is a joint venture of J. W. Briggs, J. N. Conley, and G. D. Dennis & Sons, Incorporated of Redding.

Bids were opened February 6, 1963, for the third contract which calls for subbase, base, and paving of the entire 10½ miles. Depending mainly on weather, work is expected to get underway by May 1 and traffic should be rolling over the new route by the end of 1964. Again, however, weather or other delays in the unpredictable Sierra could push completion into the 1965 construction season.

Drill, Shoot and Shovel

Mainly drill-shoot-and-shovel operations, the two initial contracts involve an estimated total of 4,000,000 cubic yards of roadway excavation—mostly solid rock or boulders with some scraper work on the lower east slope.

In these two jobs there is also included construction of interchange structures about one-half mile west of Soda Springs, at Castle Peak near the summit, and above the west end of Donner Lake.

In replacing the scenic, although narrow and circuitous route which winds up the steep eastern escarpment of the Sierra, the new alignment will have a maximum 5 percent upgrade and 6 percent downgrade. Each opposing set of lanes will in effect be separate highways with varying grades and medians. Throughout maximum uphill sections a third lane with little or no superelevation will be provided for slow-moving vehicles such as transcontinental truck-and-trailer rigs.

On the east slope, viewpoint areas for each set of lanes will offer a sweeping scene of Donner Lake, the craggy face of the Sierra, and the Truckee Valley. Near the summit there will be two safety rest areas.

The 1961 summit area traffic census indicated an average daily traffic of 6,500 to 8,200 vehicles with peak-day averages—Saturdays and Sundays du-

ing July, August, and September—of 9,700 to 12,600 vehicles. Trucks and buses comprise 12 percent of the total. Hourly volumes of commercial vehicles are unusually uniform throughout the day with 75 percent of total volumes occurring within a 12-hour period.

Maximum Snowfall 65 Feet

Records show that over the past 50 years at the summit average annual snowfall has been 35 feet and the recorded maximum 65 feet. The snowpack annually averages 10 feet, but in 1952 it was 26 feet and in 1924 less than 4 feet. Temperature ranges from 27 degrees below zero to 87 above. Winds in excess of 90 miles per hour have been recorded above the present summit highway.

Snow and wind conditions were given primary consideration in the location and design of the freeway. Although 100 feet higher than the existing route, the new road will be more sheltered from the high winds which cause serious snowdrift problems. Wind velocities here are only 15 percent to 25 percent of those along the old road.

To further minimize snow removal difficulties, flat cut slopes in drift areas are used with sufficient right-of-way and median width to permit at least a 100-foot throw either right or left of both sets of lanes.

This design will eliminate many winter traffic tieups and delays such as those caused by skidding vehicles, jackknifing truck-trailers, and by vehicles unable to move after stopping.

Nevertheless, some traffic delays and even possible closures can be expected at times because of the absolute lack of visibility during blizzards. Even though the district's experienced and well-trained snow removal crews may be able to maintain passageway to reach and clear drifts, it will at times be necessary to keep traffic off the highway until visibility permits safe driving.

Probably by End of 1964

Barring unforeseen delays, then, by the end of 1964 a continuous four-lane freeway over the rugged Sierra-Nevada will be a reality. As a matter of fact, motorists will enjoy the advantages of safer, faster travel over freeway and expressway all the way from San Francisco to the Nevada line without a single stoplight, except for the portion through Sacramento. The slow, tortuous waits in long queues of stalled vehicles will be a memory of the times before modern progress, equipment, and engineering know-how tackled the treacherous Sierra.

(Incidentally, by the end of 1964 work is expected to be underway on at least part of the Interstate 80 route through Sacramento.)

It has been said that the engineers who planned, designed, and are building this trans-Sierra interstate freeway were much too close to the picture to fully realize the immensity of their undertaking. To the engineer the total project was largely just more yards of excavation, more tons of base rock, and more yards of concrete. It has taken the lay person at large to impress upon us the terrific magnitude of this remarkable highway project even though it is not yet fully completed.

It was a source of particular pride to the district that this project was nominated for the Outstanding Civil Engineering Achievement of the Year (1962)—an annual award made by the American Society of Civil Engineers.



Looking east in reverse to photo on opposite page. Split-level roadways climb side of ridge on steady, easy grade, eliminating steep, tortuous climb up east face of Donner. Additional lane will be provided on upgrade roadways for slow-moving vehicles.

Scenic Highways

Inter-Agency Report Recommends Conservation of 'Scenic Resources'

The Legislature should designate nearly 5,000 miles of California roads as "state scenic highways" as part of a campaign to preserve the State's natural beauty, an interagency committee said in a report submitted to the Legislature on March 15, 1963.

Calling protection of California's natural resources "a matter of statewide concern," the committee said it deserves priority consideration in all of the State's public works programs.

The committee said that the "quality of the living and working environment and access to natural beauty are playing a significant role in industrial plant location and long-range investment decisions . . .

"It follows . . . that few, if any, programs can have a greater impact on these resources than highways, and that few programs offer a greater potential for guaranteeing their long-term enjoyment," the committee said.

The interagency committee based its report on a study made at the request of the 1962 legislature. Senators Fred Farr and Randolph Collier sponsored the legislation which led to the study.

Governor Edmund G. Brown praised the committee for its "significant contribution in our struggle to conserve California's beauty" and gave the report his "full support."

"I hope the Legislature will act on these recommendations without delay," he said.

Senator Farr called the report "bold and imaginative" and said he hopes the plan will be translated into action at once.

"If we hesitate, our scenic areas will be devastated by the inexorable lava-flow of urban sprawl, billboards, and the sleazy succession of hamburger-hot dog emporiums that constantly pour from our erupting metropolitan centers," Senator Farr said.

Citizens' Committee Participates

The Department of Public Works co-ordinated the study, in collaboration with the Departments of Conservation, Parks and Recreation, and Water Resources and the State Office of Planning. A seven-member citizens' advisory committee, headed by Dee W. MacKenzie of Sacramento, participated. Thirteen local workshop sessions were held in various parts of the State.

The general conclusions of the report also include:

"That the Division of Highways bear responsibility for successful execution of the program for that part of the scenic corridor within the highway right-of-way;

"That the Resources Agency, acting through the Department of Parks and Recreation in particular, bear a major share of the responsibility for scenic conservation within the corridor but beyond the right-of-way;

"That local governments accelerate and improve their planning efforts aimed at conservation of scenic resources in the areas traversed by the recommended scenic routes.

"There are only three ways," the committee continues, "in which these resources can be safeguarded through state action:

"First, state agencies can acquire rights and interests in lands that require scenic protection.

"Second, the various state agencies can apply skilled planning and design talent to their programs and achieve maximum co-ordination of scenic conservation efforts.

"Third, at the local level the state government could encourage and provide guidance in the control of land use and development."

"Scenic Highway" Defined

The report defines a scenic highway as a portion of the state highway system which fulfills the usual requirements of traffic safety and capacity, which "traverses areas of outstanding scenic beauty," and whose location, design and construction "receive special attention in terms of impact on the landscape and visual appearance." Cities and counties are encouraged to establish scenic routes on local roads and streets not under state jurisdiction.

A scenic corridor is described as generally adjacent to the highway right-of-way extending as far "as is reasonably required to maintain effective control of the scenic appearance of the landscape as viewed by the motorist."

With regard to costs the report states:

"There is absolutely no presumption on the part of the study group that gas tax funds would be used for any other purposes than those permitted by existing constitutional or statutory provisions. One of the central facts about the proposed program is that these provisions in no way inhibit proper planning, design, and construction of high-quality scenic routes.

"The remaining question concerns the cost of acquiring the fee or lesser interests or rights in real property for scenic protection-conservation purposes beyond the right-of-way. This question can be answered easily. Whether the Division of Highways or another state agency performs this function, the funds must come from federal sources, the General Fund, or from bond funds. There is also the possibility that gifts or dedications might come from other sources. The study group and the advisory committee consider that acquisition expenditures for scenic conservation purposes fall into the same category as land acquisition for other recreation and conservation purposes."

Recommendations Listed

The report contains the following recommendations for action:

1. The Legislature should formally designate the state highway routes shown on the accompanying map as "state scenic highways," the designation be reviewed quadrenially in the same manner and concurrently with the required four-year review of the

California freeway and expressway system. Designation action should be accompanied by an appropriate statement of legislative policy and intent, setting forth the social and economic development objectives sought through establishment of the scenic highway program, and providing a clear set of policy guides.

2. The state government acting through the several departments directly involved, should be given comprehensive and explicit authorization to acquire the fee or any lesser interest or right in real property for scenic conservation purposes.

3. Existing legislation governing the control of outdoor advertising along state highways should be strengthened to permit more effective and consistent control of such advertising in scenic areas.

4. The Department of Public Works should explore the possibilities for using funds available under the provisions of Section 319, Title 23, U.S. Code, for scenic conservation purposes along federally aided highways. The department should formally ask the Bureau of Public Roads for a policy determination and establishment of procedure respecting use of these funds.

5. The Division of Highways should develop any necessary standards and procedures, as experience may indicate, to guide location, planning, design and construction operations affecting designated state scenic highways, as the implementation of Circular Letter No. 62-161, issued May 29, 1962, on Scenic Values in Planning and Design.

6. The Division of Highways, as a part of its ongoing program, should undertake "pilot" scenic highway projects for the purpose of determining in actual practice the technical problems and requirements involved, the needs to be met in the scenic corridor by other state agencies, and to identify effective areas of needed cooperation between state and local government with regard to protection of the corridor.

7. The Legislature, by concurrent resolution, should request counties and cities to review their planning programs and their zoning and other regulatory procedures with the objective of developing adequate planning and regulatory measures for control of land use and development within the scenic corridors abutting state scenic highways.

8. The Department of Parks and Recreation should undertake two efforts: (a) it should develop complementary procedures for identifying and analyzing scenic resources and for specifying the nature and extent of conservation measures to be undertaken outside the highway right-of-way; and (b) it should develop a plan and program for both the development of specific "wayside" or "strip" parks, and for the integration of its larger proposed projects with scenic routes.

9. Because of the great importance of local planning and land use regulation for the success of the scenic highway program, the State Office of Planning should provide technical assistance to, and should urge the participation of, local governments in the preparation of general and precise plans and in the development of measures for carrying out such plans.



Location of the highways which are recommended to be included in a state scenic road system is shown in the above map.

$4,000,000 Damage By January Storms

Favorable weather following the storms in late January enabled maintenance forces, assisted by contract labor, to restore traffic through the many damaged sections of state highways in February. Preliminary estimates indicate a total damage of $4,000,000 to highways in Northern California.

All damaged sections have been reopened for normal traffic with the exception of several one-way locations on U.S. 40 Alternate along the Feather River and at Spanish Creek near Quincy; on State Sign Route 49 west of Downieville; and on State Sign Route 1 south of Big Sur.

Webster St. Tube

Underwater Crossing Completed in East Bay

By W. C. NAMES, Resident Engineer, and
WILLIAM F. WOLFSON, Assistant Resident Engineer



Following dedication ceremonies at 12 noon on February 13, 1963, the Webster Street Tube was placed in service as a new underwater vehicular crossing between Oakland and Alameda.

With the opening of the new tube, its precedessor and neighbor, the 35-year-old Posey Tube, was shut down for modernization. Late in 1963 the Posey Tube will be reopened and then each tube will carry two lanes of unidirectional traffic. The result will be a much freer flow of traffic between the two cities; a single two-lane tube will no longer be required to carry up to 30,000 vehicles a day.

The Webster Street Tube cost approximately $17,000,000 to construct, spread over a period of 3½ years.







PHOTO ABOVE. A section of the completed subway just before it was opened to traffic. BELOW LEFT The tube portal from the Oakland side. BELOW RIGHT. The tube portal looking from the Alameda side toward downtown Oakland.

Other "vital statistics" include: tube segments, total of 12, each weighing 11,000,000 pounds; 67,000 cubic yards of concrete; maximum roadway depth, 72 feet below mean sea level; length, including approaches, 5,923 feet; roadway width, 24 feet; vertical clearance, 15 feet.

Previous articles in *California Highways and Public Works* described the design of the tube (March-April 1960) and the first stages of construction, including the precasting of the tube segments (January-February 1961).

This past year has seen the completion of the placement of the tube segments and the construction of connecting cast-in-place section between the Oakland portal building and the last precast segment.

Installation of the control and ventilation equipment was completed in the portal buildings. Final items of work involved completing the tube interior, placing tile and fluorescent lights, constructing the approaches to city streets and final testing of the control and ventilation equipment.

Placing Tube Segments

Of special interest are the methods used in placing the tube segments. The Alameda portal building had to be completed before the first tube segment could be placed.

Segment placement started at the Alameda portal building and proceeded north toward Oakland. To position the segments the south end was coupled to the north end of the previously placed segment. The north end was positioned on two groups of four piles each. These were 20-inch pipe piles about 130 feet long driven to approximate position by barge rig using a double-acting steam hammer.

The piles were cut off and an insert with a sharp pin facing upward was placed in the pile. This insert was used to make an indentation on a timber template which served as a guide for the construction of the timber and steel crushing block and support frame which was placed on the piles to support the tube collar.

A bottom tremie form, consisting of a four-foot deep steel tub with rolled edges, was placed at the center of the joint adjacent to the support frame.

GEORGE GREENE RETIRES

On January 1, 1963, George A. Greene, resident engineer on the Webster Street Tube project, retired after 32 years of service with the California Division of Highways.

Greene was born in Great Falls, Montana, in 1898 and attended elementary school in Seattle, and high school in San Pedro, California, where he moved with his family in 1913. After graduation from high school, he attended the California Institute of Technology and the University of California, where he received his bachelor of science degree in civil engineering in 1931.



GEORGE A. GREENE

After working a year as a surveyor with the Los Angeles Harbor Department, Greene began his state career as assistant resident engineer on bridge construction. With the start of work on the San Francisco-Oakland Bay Bridge in 1933, he was assigned as chief of party for primary triangulation and later was in charge of caisson-setting and cable-spinning operations. Greene's later assignments included a four-year period as project designer on major bridge projects and several years as resident engineer on bridge construction throughout Northern California.

In 1953 he was promoted to senior bridge engineer and was assigned as bridge construction supervisor for bridges in District III. During the ensuing six years, he was at various times responsible for supervision of bridge construction in Districts II, III, V, VI and X.

In 1959 he was assigned as the state's resident engineer on the construction of the Webster Street Tube—an 18 million dollar subaqueous tunnel beneath the Oakland Estuary between Oakland and Alameda. He served in this capacity until his retirement.

The ballasted tube was given final cleanup, the collars and ring seal cleaned of mud, the anchoring and rigging lines attached, and submersible pumps installed in the ballast tanks.

Scheduled in Advance

Tube placement had to be scheduled accurately in advance as the channel was closed to ship traffic on placement day to prevent any water surges due to the ship's wash or wave action. Smaller craft were allowed to pass at reduced speed.

The Army Engineers and the Coast guard required two weeks' notice prior to the closing of the channel. Therefore, once a target date was set and permits received for the channel closing, the schedule had to be met. On occasion this meant working overtime and on weekends to make up time, but all scheduled placement dates were met.

The contractor shifted the channel as his excavation and tube placement required. The manholes and access pipes were designed at different ends of the segments to facilitate the shifting of the channel as the various phases of work progressed across the channel.

The steel H-beam dolphins used in positioning the segments had to be removed in conjunction with channel shifts. The contractor had the channel tied up for a period of two years with a restricted width for seven months.

Four tugs brought each segment into position for final ballasting and transfer to the derrick barges which were used for lowering of the tube.

Water Ballast

Water ballast was pumped into the bulkhead space beneath the roadway slab by a 6-inch diesel driven pump mounted on a barge. Water ballast was removed when required with the submersible pumps in each compartment (tank). About 600 tons of water was pumped into the end tanks and approximately 150 tons was sprinkled through spray pipes over the sand ballast on the roadway. This operation took place on the day of placement and required nearly half a day. This ballasting provided a 50-ton negative bouyancy uniformly distributed from end to end.

A derrick barge at the north end and a barge crane at the south end secured the tube with wire slings. The derrick barges were positioned on tight wires either to shore, to anchors, or to steel H-beam dolphins driven specifically for this purpose. With the barges in position, guy wires from the segment were run ashore or to steel dolphins from the tube to assure accurate horizontal position. These wires were controlled by winches on the shore or on the dolphin platforms.

The segment was lowered in a level position until it neared the coupler slots, then the north end was raised 15 feet, very slowly, then the lowering resumed. As the coupler arms entered the guide slots, lowering was stopped. A continuous check was made on the tube's elevation and alignment by instrumentmen on transits and levels checking the relationship of sighting masts to obtain and maintain position control. Two-way radios were used to co-ordinate the work.

Divers Check Position

Divers descended to check the position at the joint and made sure that the rubber seal ring had slipped over the rim of the positioned tube and that the couplers were seating properly.

With the couplers engaged, the north end was lowered until it rested on the crushing block pads, the final alignment being made by adjusting the tension on side breast lines to move the segment one way or the other while it was being lifted by the derrick crane. Alignment and elevations being satisfactory, the final position was noted and additional ballast pumped to completely fill the tanks and saturate the roadway ballast. The negative loading was thereby increased to about 300 tons. The load on the previously positioned tube was reduced to avoid overloading the temporary support piles.

In placing segments 11 and 12, on the Oakland side, the working room was restricted to a 100-foot width between the Haslett Warehouse bulkhead and the steel H-beams and sheet pile wall on the east edge of the excavation. The room at the north edge of segment 12 was limited by the 105-inch sewer and the Water Street railroad bridge.

Floated in Excavation

Segment 12 had to be floated into the excavation and tied off before segment 11 could be placed. Segment 11, when placed, would be too shallow for segment 12 to float over it.

Lack of room prevented the derrick barge from being in its normal position and the segment was lowered with the derrick barge facing sideways or backed over the segment after it had been submerged below the barge's waterline.

Survey control during placement consisted of a level set up to read the elevations on four corners of the segment, and a transit set on a line parallel with the centerline of the segment which was able to line up the points on the north and south sighting masts. These same points were used to check for tube settlement after the segment was placed.

Considering the difficulty of the work involved and the potential dangers and number of things that could go wrong, the placement of the segments was one of the most efficient and smoothly controlled operations of the project.

Steel Forms Installed

After placing the segments and prior to placing the sand bed at the joints, steel tremie forms were installed at the sides of the joints of the joining tubes. These were half-cylinders, 8 feet in diameter and 42 feet long with edges of split sheet piling to mate with the other half of the sheet piling previously attached to the collars of the segments. These were lifted vertically and slid down in interlock until the bottom of the cylinder rested on the projecting semicircular end of the tremie form previously placed under the segment joint.

Before a tube segment could be bedded, the next segment had to be in place. Tube beds were prepared by placing backfill sand from a hopper dredge under the tube.



Preparing a tube segment for placement. Note the twin sighting masts used for survey control and the manhole used for access and ventilation being lowered into position by the crane.

Backfill sand was placed under the tube by a terminal barge with movable sections of 12-inch steel pipe, which had a long "nozzle" which could be lowered alongside the tube. Its end was bent to direct sand underneath the barrel of the tube. Additional turbulence was provided by a two-inch high-pressure water jet.

Tight-packed Sand Base

The action of the water jet combined with the tidal movement created a tightly packed base of sand under the segment. All segments were bedded into the sand by increasing the ballast to 600 tons or more. This loading was sufficient to fail the temporary supports if they received the full load after a settlement of four inches. Continual settlement checks showed the segment settlements varied from three-fourths inch to three inches before the sand picked up the load.

After each segment was bedded and survey checks confirmed vertical stability, the joint at the south end of the previous tube was prepared for concrete tremie seal.

Prior to placing the concrete the joints were cleaned of sand and mud by use of an air lift pump. Water jets were used to move sand to an accessible location and for cleaning marine growth from the tube collars. Any openings in the tremie forms were caulked with burlap or sandbags.

A special frame was constructed to support the tremie pipes. It was equipped with a small gas engine and winch utilizing a pully system to raise or lower the tremie pipes.

The tremie frame was supported by steel pipe legs which rested on the collars.

Derrick Barge Used

The tremie concrete for joints 1-2 through 5-6 was placed by using a derrick barge and a two-cubic yard concrete bucket swung from the Alameda shore to the segment joint. Joints 6-7 through 8-9 were placed by transporting the concrete buckets via tugs or landing craft scows to the joint where it was placed by derrick barge. The balance of the joints were placed by derrick barge from the Oakland shoreline.

Tremie pipes ran down each side of the joint. Concrete placement started



The subway interior work in progress with the wall, walk and ceiling forms in place. The 10 ducts inside the wall form are for telephone cables. Note the limited working space and the difficult access conditions.



Placing the ceiling tile in the tube segments from above. Gummed paper is laid on the ceiling form, the paper moistened, and the tile placed face down on the paper. Next, the slab reinforcing steel is placed and then the concrete, including an inch of grout cover over the tile. The paper is then removed, exposing the tile.

on one side, the concrete was designed to flow under the segment and allowed to build a lift of about 12 feet on the opposite side from that where concrete placement started. At this point the tremie is about 12 feet higher on the starting side. Concrete placement is shifted to the other side, the lifts balanced and the placement continued using both tremie pipes. The pipes were raised and the segments removed as the placement progressed.

During the placement of concrete the divers laid sandbags along the top of the collar to direct the flow of concrete toward the center of the segment and to retain the concrete within the tremie area.

As the concrete cleared the top of the collars it had developed a crust which was helpful in directing the flow toward the center of the segment. Concrete placement continued until the concrete flowed under the sandbags at the center of the joint. A center pipe was available if the concrete broke over the side prior to flowing to the center.

Backfill Operation Started

The backfill operation was started after allowing adequate time for the tremie joints to obtain strength.

Sand used for backfill material was the same as that used for bedding the segments. Sand backfill used over segments 1 through 12 was dredged by the hopper dredge *Sand Piper* off Angel Island. Most of the sand used at lower elevations under water was of a medium grading, some coarser sand was used in the Alameda fill area behind the bulkhead line over segments 3, 4, and 5. The dredge used had a capacity of 1,150 cubic yards and except for maintenance and shutdowns, was capable of three shifts per day.

Segments 7, 8, and 9 are in the center of the channel and require the maintenance of a 40-foot-depth clearance for ships.

To provide adequate ballast and prevent uplift of these segments a five-foot layer of heavyweight iron ore rock was placed uniformly over the segments.

Upon completion of heavyweight placement, a two-foot layer of sand was spread uniformly over the heavyweight material.

Subway Interior Work

Subway interior work began as soon as the segment joints had been sealed.

It consisted of work required for the completion of the subway interior between the covered section of the subways (including portal buildings). Work included removal of bulkheads and ballast, placing of all reinforcing steel, PCC, embedded items, tile, electrical, ventilating, plumbing, lighting systems, and other miscellaneous items of work.

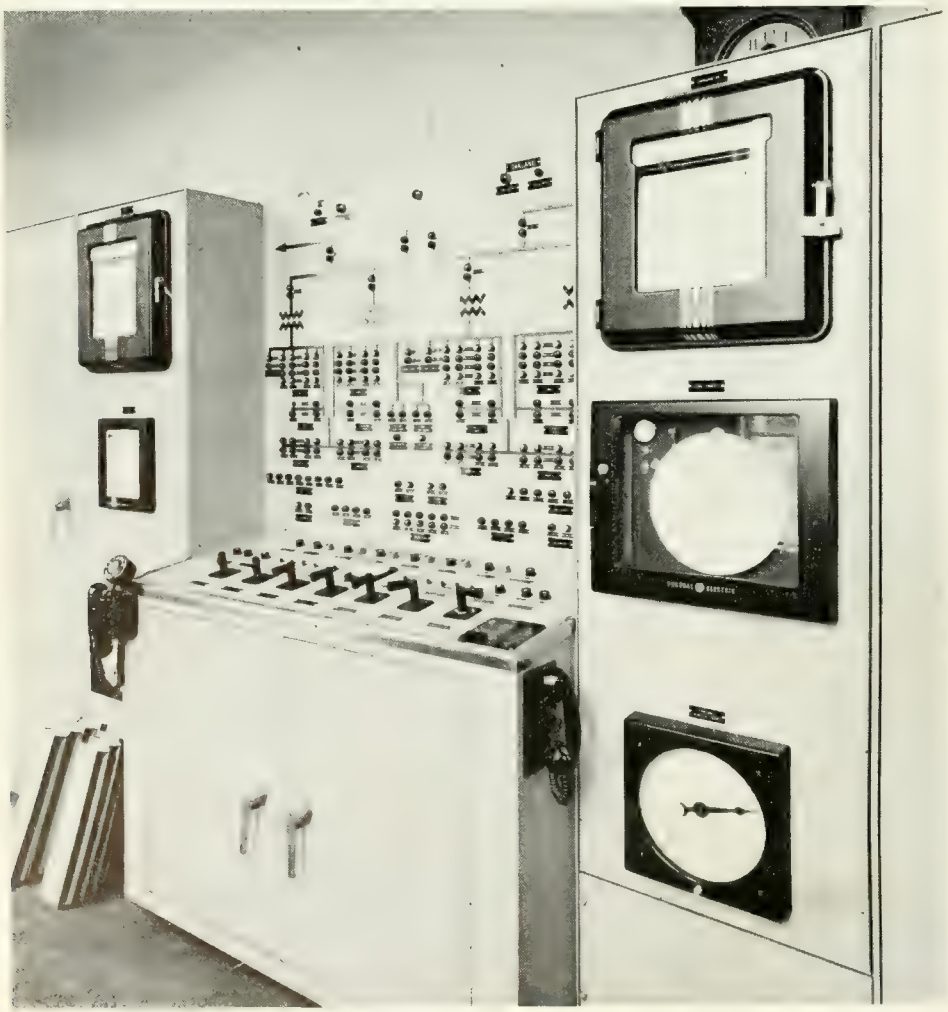
Work within the precast segments, beginning at the Alameda portal building, began at each joint with the removal of temporary end bulkheads.

The chamber between the ends of the segments, on the opposite side of the tremie concrete and adjacent to the rubber seal ring, was pressure grouted after steel plates were welded to the curved embedded angles. The grout consisted of a 4:1 mix by volume with special admixtures and was placed under an average pressure of 100 psi. In a few joints grout seeped out under the embedded angles. Seepage areas were later chipped out and patched with a mixture of cement and an accelerating agent.

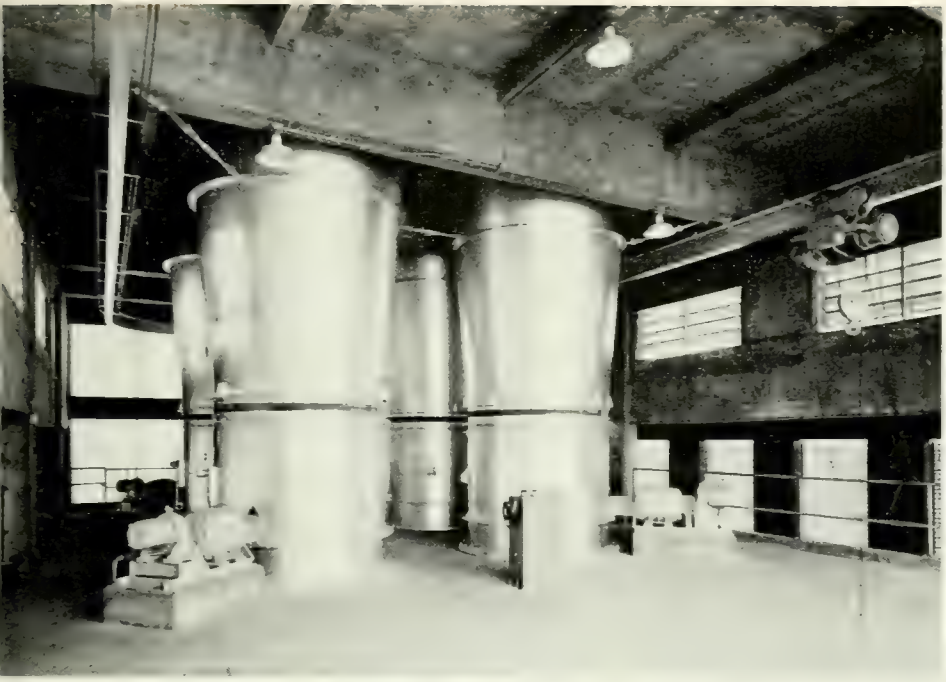
The concrete fill in pours between the joints were placed by using sections of the same forms used in casting the tubes.

Sand Ballast Removed

Ballast equipment, catwalk, and water and sand ballast were removed from the roadway slab after sufficient backfill was placed over the segments. Sand ballast was removed from the roadway slab with rubber-tired loader and hauled out in flatbed or dump trucks.



The completed control panel for both tubes in the old Posey Tube control room.



Some of the exhaust ventilation ducts in one of the portal buildings.

Curb and side concrete was placed using wood forms.

Forms for the ceiling slab were constructed of steel and consisted of heavy channel sections supporting steel plate and plywood decking spanning the widths of the subway. Forms provided a surface for placing the ceiling tile by the upside-down method and provided support for the ceiling slab concrete. Legs of each unit (10, 40, or 50-foot sections) of the forms rested on the ledge or sidewalk and was anchored to the sides with form bolts. Forms were moved and set in position by means of a form traveler, which moved on rails on timber pads) resting on the roadway slab. Forms for 210 linear feet of ceiling slab was available.

Portland cement concrete for the ceiling slabs was generally placed by "buggying" concrete over previously poured sections of the slab and on runways in the section being poured from hoppers set under the access manholes at one of the segments. Concrete was discharged into chutes set in the top of the access manholes outside the tube. In a few instances a conveyor was used to fill a hopper placed on the form traveler set outside of the pour area.

Placing of ceiling form reinforcing steel followed placing of the upside-down tile. Concrete was placed directly on freshly placed grout spread over the tile. The concrete contained 0.5 percent of calcium chloride to accelerate setting time for finishing purposes. Pours were made weekly (two-week cycle) usually in lengths of 95 to 105 feet until the forms could not be moved ahead.

Final interior work consisted of placing the wall and side tile—1,600,000 pieces—and installing the light fixtures.

The use of continuous fluorescent light fixtures in conjunction with the light green tile presents a most attractive and appealing subway. The roadway is paved with plant-mix asphalt and is an interesting contrast.

Electrical, Mechanical Equipment

Necessary for the efficient and proper operation of a modern subway is a ventilation system capable of producing fresh air in adequate amounts as needed, and an electrical system which can control it automatically.

The Webster Street Tube supplies up to 1 million cubic feet of air per minute and is controlled by both traffic evaluators and carbon monoxide indicators.

The ventilation equipment and electrical control system were installed during the past year. Final wiring and the elimination of minor operational "bugs" from the system required about four months time. The testing and final checkout of the system brought the Webster Street Tube construction to an end.

Sacramento Bridge Construction Starts

Initial phases of construction have started on the substructure of the new Sacramento River bridge west of W Street.

Test piles have been driven and cofferdam assembly is underway in the contractor's workyard.

Early in March the contractor moved onto the site and set up a field office and equipment house, and stored sheet piling. Existing docks are being removed or revised for use during construction.

This initial project includes building three reinforced concrete piers, protective fenders, and a navigation lights system. Under a $1,500,000 contract to Fruin-Colnon Contracting Co. and Le Boeuf Dougherty Contracting Co. of Burlingame, the job is expected to take a year or more to complete.

Resident engineer for the Division of Highways is R. N. Brink of Sacramento.

The eight-lane superstructure plus slightly over a mile of freeway approaches to the span will be built with the $11 million included in the fiscal 1963-64 highway construction budget.

Overall, this first section of the future east-west Interstate 80 freeway through the central Sacramento area will extend from the Sacramento Northern tracks in West Sacramento to Fifth Street between W and X Streets in Sacramento.

Adjacent sections will be advertised for bids after funds are made available, probably in the next year or two.

The bridge and freeway approaches will be on a completely new alignment south of the present U.S. 40 route into Sacramento and will not affect traffic during construction.

Conway Grade

Important Summit Section Completed in Three Work Seasons

By GENE J. SNYDER, Resident Engineer



On October 25, 1962, after three seasons of work, the Conway Summit project was completed in District IX. The new alignment in Mono County, between the foot of Conway Grade and 0.5 mile north of Conway Summit, aproximately 4.2 miles in length, eliminated one of the most serious bottlenecks on the Three Flags Highway (US 395) between Canada and Mexico.

The old Conway Grade was originally built in 1921 and 1922 by State Contract No. 300 which was awarded to the Nevada Contracting Company for 19.1 miles of grading work between Lee Vining and Bridgeport. Previous to this project the road from Lee Vining to Bridgeport digressed easterly around Mono Lake then through Bridgeport Canyon to reach Dogtown south of Bridgeport, thus avoiding the formidable Conway Summit.

Contract No. 300 struck boldly out from Lee Vining and went up and over Conway Grade in a venturesome project for the time. This project completed in the summer of 1922 was by far the largest project ever let in Mono County at the time and in fact its final cost of $234,742 was considerably greater than all the money spent for highway construction in Mono County from that time back to the beginning of the state system.

Oiled Earth Surface

The old Conway grade was widened and paved with an 18-foot oiled earth surfacing in 1931 and until construction of the present project the only improvements made to the grade have been the application of some light bituminous blankets, seal coats and the construction of some guardrail.



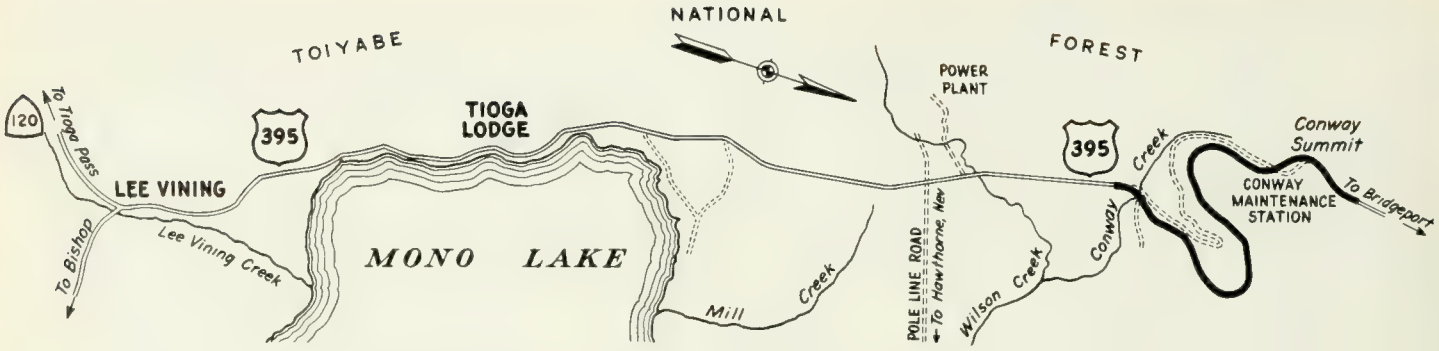
A section of the new highway over the 8,136-foot-high Conway Summit. Note the southwest cuts on the left laid back for maximum exposure to the sun.



This photo, taken during construction, shows the five-bench cut near the summit.



A portion of the Conway Summit project looking out over Mono Lake with the snow-capped eastern slopes of the Sierra beyond.



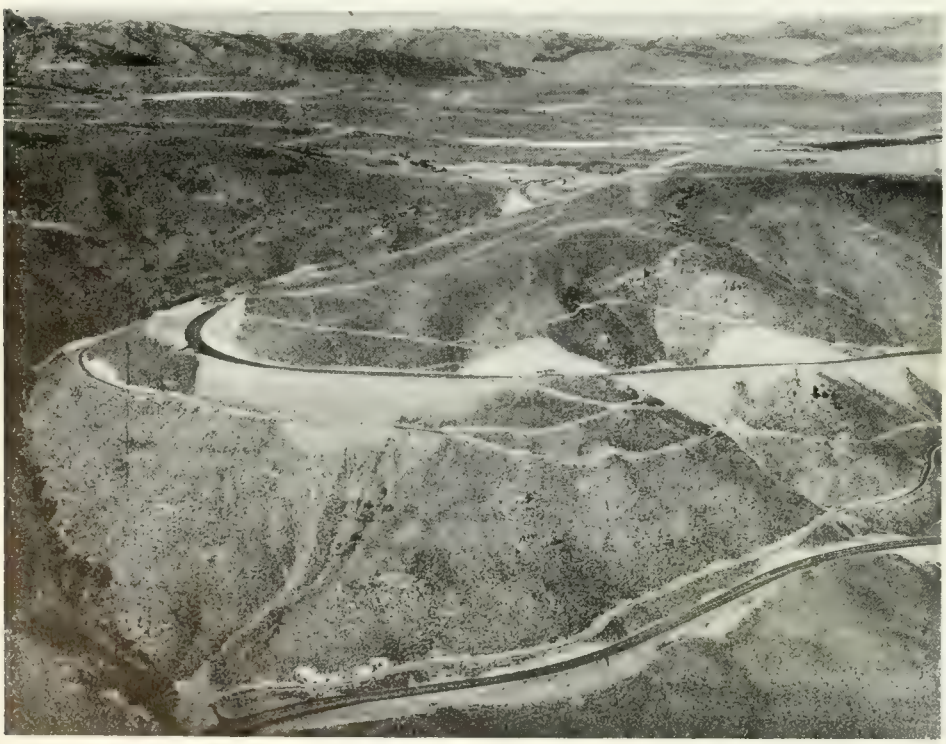
A map showing the location of the Conway Summit area on U.S. 395 in Mono County.

The need for major improvement has long been apparent, but costs could not be met. In 1938 a field review of this project was made and a "reconnaissance report" was submitted discussing four possible alternates for improvement. Funds were allocated for engineering reports in 1945 and 1948. Finally, in 1953, a project report and aerial surveys were authorized which resulted in adoption of the new route by the State Highway Commission in August of 1956. Funds for the construction of this project were made available by the commission in October of 1959 and the last big hurdle had been cleared for a long overdue modernization of Conway Grade.

New Alignment

The new alignment has been located primarily to the east and right of the old grade. The minimum radius of curve is 850 feet and the maximum grade is 6 percent. The new alignment includes 13 curves compared to 63 on the old grade. The standard 60-foot four-lane all-paved section was used throughout. The structural section provided for 0.25 feet of type B asphaltic concrete on 0.50 feet of class 2 aggregate base.

An interesting feature of the design was the construction of a low 10-foot wide bench in the cuts for snow storage and slope ravelling. The cut slopes on the southerly sides were laid back for maximum exposure to the sun. Conway Summit at an elevation of 8,136 feet is the highest point on U.S. 395, and snow removal is a major problem. At two locations on the grade, additional lanes were constructed on each side of the roadbed to provide parking space for vehicles installing and removing tire chains in the winter months. At approximately one mile below the summit a parking area with acceleration and deceleration lanes was constructed to provide southbound motorists a safe place to stop and enjoy or photograph the spectacular view of Mono Basin and Mono Lake.



Looking northwest above the Conway Grade. The Conway Summit Maintenance Station can be seen in the middle background.

Contract Awarded

The contract for construction of this project was awarded to Ball and Simpson, Contractors, in April of 1960. The work was scheduled to be completed in two seasons, as 300 working days were allowed. However, due to the extremely rugged terrain and encountering roadway material that was very difficult to excavate and compact, the project took three seasons to complete even though the contractor worked his grading crews two shifts most of the time. The final cost of the work was $2,084,000, the largest ever undertaken by the State in the Inyo-Mono area.

The fills on the summit end of this project were constructed of a glacial moraine material excavated from cuts in the last mile and a half of the new alignment. During the winter suspensions of work the surfaces of fills constructed of this material slumped and eroded quite severely. It appears that as the snow melts in the late winter or spring, particularly on the fills with



The view southward from the observation point located a mile south of the summit.

southerly exposure, a layer of surface material becomes saturated and small slumping occurs, starting at the toe of the slope. The slumps were rather small, usually not more than 10 or 20 feet in diameter and extending in depths from one to three feet below the surface. The slumps progressively occurred up the face of the fills and considerable erosion occurred at the same time. Debris from the slumps and erosive action traveled several hundred to several thousand feet from the points of origin.

Corrective Measures

The slumps that occurred in the fills approached the shoulder of the roadbed but in no case have these slumps actually encroached in the top of the fill. Corrective measures taken to date consist of backfilling the numerous slumped areas in the upper 40 to 60 feet of the fills with granitic material.

Although the new alignment is slightly longer than the old, travel time for a passenger car has been nearly cut in half. The savings in time, reduction in driving fatigue and traffic congestion will multiply through the years to come and the savings in cost to the motorist will soon repay the initial investment in this modern highway.

During the period of construction of the Conway Summit project three engineers on the District IX staff, under District Engineer C. A. Shervington, successively held the position of resident engineer. They were Charles H. Jackson, Robert F. Yeager, and Gene J. Snyder. J. R. Jarvis is district construction engineer and the contracting firm, Ball and Simpson, was represented by Superintendent Russell G. Webster.

LOOP TRAFFIC STUDY

A traffic study of the loop portion of the Santa Monica Freeway between the Santa Ana and Harbor Freeways has been made by the Division of Highways office in Los Angeles. It reveals that the new freeway section has caused a drop of 25,000 vehicles per 24 hours on the Santa Ana Freeway between San Pedro and Alameda Streets, and a reduction of 47,350 vehicles at locations on Washington, First, Sixth, Seventh, Olympic and Venice, all major paralleling surface streets.



The Terminal Island Bridge. Towers are 365 feet high; the center span 1,500 feet long.

District VII Freeways

By EDWARD T. TELFORD
Metropolitan District Engineer



On the opening to traffic of the San Diego Freeway through the Santa Monica Mountains last December 21, San Fernando Valley realtors took a full-page ad in the Santa Monica *Evening Outlook*, heralding in effect the travel time savings and increased accessibility between San Fernando Valley communities, West Los Angeles, Santa Monica and the bay cities. Public response to the new facility was instantaneous as 82,000 motor vehicles diverted from paralleling mountain routes to the new facility in the first full day's operation. Sepulveda Boulevard, which had been carrying an average daily traffic of 42,000, dropped to 3,000. Peak-hour travel time was cut in half, from 14 minutes on Sepulveda Boulevard to 7 minutes via the freeway.

Similarly, across the three counties of Orange, Ventura and Los Angeles, together comprising District VII of the State Division of Highways, public reaction was equally enthusiastic as critical new sections of freeway were added to the expanding transportation network in this part of Southern California, providing connecting links and alternate routes where previously there had been gaps and incomplete projects. Thus, the 45.6 miles of new freeway opened to traffic in the district during 1962 brought about far-reaching highway user benefits. The trucker and the motorist could now, more than ever before, travel to their destinations via a combination of continuous routes with increased speed, economy and safety.

The 4,000,000 plus motor vehicles in Orange, Ventura and Los Angeles Counties logged 5,800,000,000 vehicle miles over the freeway system during 1962 alone, equalling more than 31 round trips to the sun. As a result of freeway driving, these motorists saved $63,000,000 in operating costs, $12,000,000 in accident costs and $221,000,000 in time savings.

Among the significant freeway completions contributing to the above-mentioned highway user benefits during last year, were the downtown freeway loop, portions of the Golden State and Santa Monica Freeways skirting downtown Los Angeles; the Harbor Freeway between Pacific Coast Highway and 190th Street, completing the route throughout from the four-level structure in the Los Angeles Civic Center to Battery Street in San Pedro; the San Diego Freeway through the Santa Monica Mountains to a connection with the Ventura Freeway, and between the Long Beach Freeway at Signal Hill to Hawthorne Boulevard in the City of Hawthorne; and the Ventura Freeway between the Hollywood Freeway and Golden State Freeway.

Traffic Diversion

Shifting traffic patterns are characteristic of new freeway construction, both from freeway to freeway and surface street to freeway, resulting in diversion or diffusion of traffic volumes.

A notable example of vehicular diversion took place with the completion of the four-mile Santa Monica Freeway viaduct portion of the downtown loop as far west as the Harbor Freeway in March of 1962. This freeway link absorbed substantial percentages of traffic from the Santa Ana Freeway "slot" and relieved local city street congestion in the area.

Paralleling east-west routes from the Santa Ana Freeway on the north to Washington Boulevard on the south diverted 87,050 motor vehicles to the new facility. In the "before" period the Santa Ana Freeway had a traffic volume of 185,000 as against 160,000 in the "after" period; Olympic Boulevard 24,100 as against 19,150; and Washington Boulevard 27,650 as against 20,100. Traffic count decreases were also noted as far south as Santa Barbara Avenue, though in diminishing degree.

On the other hand, induced traffic showed a gain of 18,000 vehicles or a 6.5 percent increase on all routes in the area, so that generally improved traffic flow and higher level of service were conclusive.

Similar diversions were observed on the Ventura Freeway from the Hollywood Freeway to the Golden State Freeway. Riverside Drive, the old state highway supplanted by the freeway, had carried 17,000 vehicles per day but dropped to 4,500 when the freeway was constructed.

The extension of the Golden State Freeway northward into the San Fernando Valley reduced truck volumes using the Hollywood Freeway by 15 percent, while raising truck traffic on the Golden State Freeway by 40 percent. Current truck traffic percentages of total vehicular volumes on various freeway routes are as follows: Hollywood Freeway 6 percent, Ventura Freeway (west of Hollywood Freeway) 7 percent, San Bernardino Freeway 10 percent, Santa Ana Freeway 8 percent, Harbor Freeway 5 percent, Santa Monica Freeway 5 percent, Golden State Freeway (south of Tunnel Station) 11 percent, (north of Tunnel Station) 20 percent, Long Beach Freeway 10 percent, and San Diego Freeway 6 percent.

Average daily traffic counts over the District VII freeway network during 1962 indicated a general 3 percent rise over the previous year. The breakdown at key locations on the various routes follow:

The Coliseum and Sports Arena with the Harbor Freeway in the background. All events here were attended by a total of 2,574,000 people last year who used 400,345 automobiles and 10,000 buses. Most came via the freeway network.





The Central Manufacturing District, 3,750 industrial acres with more than 750 major industries in the City of Commerce. The area is eight miles from downtown Los Angeles and, in addition to heavy truck movements, 75,000 people travel in and out every day by automobile. The view is eastward.

1962 Average Daily Traffic

Hollywood Freeway	
Westerly of four-level structure	185,000
South of Ventura Freeway	115,000
Harbor Freeway	
South of four-level structure	185,000
At 30th Street Overcrossing	175,000
San Bernardino Freeway	
At Long Beach Freeway	140,000
West of Golden State Freeway	77,000
Santa Ana Freeway	
At Long Beach Freeway	182,000
East of Rosemead Boulevard	107,000
Pasadena Freeway	
North of four-level structure	85,000
North of Golden State Freeway	85,000
Santa Monica Freeway	
Santa Ana to Harbor Freeway	110,000
Ventura Freeway	
West of Hollywood Freeway	130,000
West of San Diego Freeway	128,000
Golden State Freeway	
West of Pasadena Freeway	115,000
North of East Los Angeles Interchange	115,000
North of Ventura Freeway	108,000
Long Beach Freeway	
At Pacific Coast Highway	63,000
South of Santa Ana Freeway	90,000
South of San Bernardino Freeway	42,000
San Diego Freeway	
At Olympic Boulevard	57,000
Colorado Freeway	
At Linda Vista	25,000
Glendale Freeway	
At Golden State Freeway	36,000
Riverside Freeway	
At Santa Ana Freeway	42,000
Using four-level structure	326,000

Time Savings

The critical test of any transportation system is the ability to move people and goods rapidly as well as safely from point of origin to point of destination. The freeway system, as has been seen in the foregoing discussion of traffic diversions and traffic volumes, is providing this service on a mass transportation basis.

As this system continues to develop into an integrated network of through superarterials, the demands put upon it and the services it will render will multiply as California continues to forge ahead of all the other 49 states in population and motor vehicle registration. Conservative projections into the year 1980 hold that California will be populated by some 30,000,000 persons with 17,000,000 motor vehicles.

As of December 31, 1962, the State of California numbered 9,873,806 motor vehicle registrations of all classifications, 4,308,997 of which were in District VII. Los Angeles County alone had 3,686,325 registrations.

The Automobile Club of Southern California, in independent tests conducted in 1957, 1960 and 1962, revealed marked gains in peak-hour travel times between employee residences and the headquarters office at Adams Boulevard and Figueroa Street in Los Angeles. The new study was released in May 1962 and recorded time and distance traveled at various points on test trips. Automobile club personnel traveled to and from all sections of the Los Angeles metropolitan area during the busiest times of day. Their routes and driving behavior were typical of Los Angeles commuters. As in previous studies, the survey was scheduled prior to school vacation and at a time free of special

events which could influence the result.

The findings of the peak-hour study indicated travel time reduction on the majority of the routes traveled. The average peak speed was 30.5 miles per hour, as against 26 miles per hour in 1960 and 24 miles per hour in 1957.

Completion of important segments of the freeway system provided the greatest increase in travel speeds. The most significant of these was the Downtown Freeway Loop, composed of the Golden State and Santa Monica Freeways. Construction of the loop relieved the traffic burden on the four-level interchange, reducing congestion in that vicinity. Completion of portions of the Golden State Freeway greatly increased the use of that route, relieving the Hollywood Freeway particularly through the reduction of truck traffic. A third important completion took place when the Long Beach Freeway was extended to connect the San Bernardino and Santa Ana Freeways. Twenty-three miles of freeway were completed in the Los Angeles metropolitan area in the two-year period between the 1960 and 1962 studies.

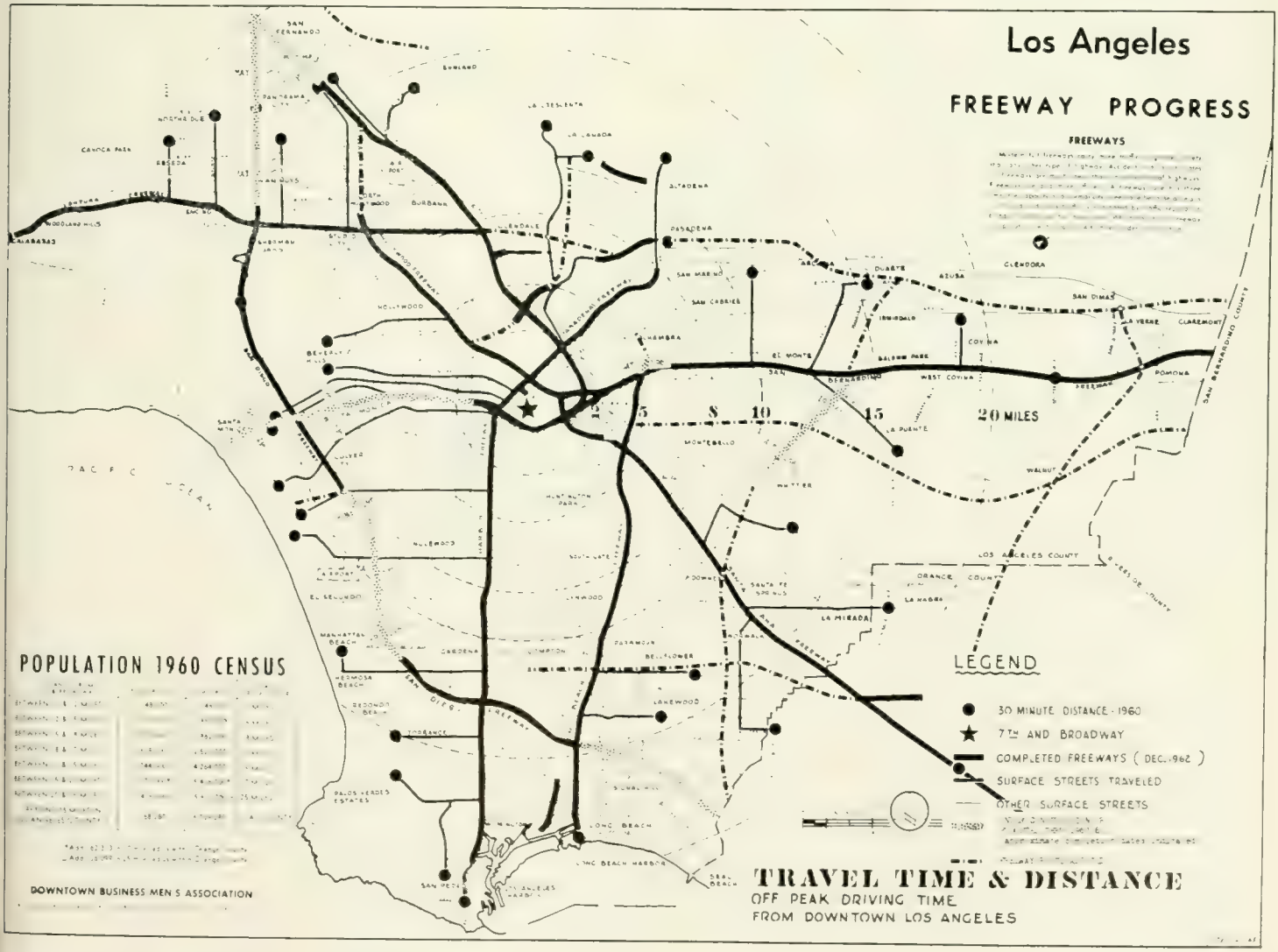
The completion of the Golden State Freeway permitted an increase in peak-hour driving speeds on that route from 30 miles per hour in 1960 to 38 miles per hour in 1962. The peak-hour travel time for the 28-mile trip from San Fernando to the club was reduced to just 44 minutes in 1962 as compared to 52 minutes in 1957.

Completion of a segment of the Glendale Freeway, coupled with the Golden State Freeway improvement resulted in a drastic reduction in travel time to Glendale, from 38 minutes in 1960 to 24 minutes in 1962. The average peak-hour speed increased from 19 to 31 miles per hour.

Improvement to surface streets on the Los Angeles County and local road systems reduced travel times in the southeast quadrant of the metropolitan area. Widening, channelization and signal improvements on Imperial Highway near Whittier, and on Telegraph and Leffingwell Roads, had the most notable effect. Travel time to Whittier was reduced four minutes and to La Habra, 18 minutes.

Persons-Tonnages

It has been shown that time savings is a critical factor in transportation, but in order to serve a high-density urban complex such as the Los Angeles area the mode of transportation



must be flexible and capacious enough to accommodate millions of persons and tons of goods simultaneously. To what extent the present freeway system is accomplishing this gigantic feat is graphically told in the accompanying tables, listing numbers of persons and commodity tonnages at selected onfreeway locations. For the seeker of novel comparisons, 60-ton railroad boxcar and 10,000-ton Liberty Ship equivalents are given in the first table.

The following tabulation indicates the heavy concentration of persons and goods in the central city. The succeeding tabulation ranges beyond these confines, illustrating the connecting nature of the freeway system and the constant high-level transportation stream into outlying areas. Significant here is the fact that the freeway system is not purely local, as in the case of rapid transit, but extends as a continuum to serve areawide traf-

Daily Number of Persons and Tons of Goods Moved at Selected Sites on Various Freeways in the Los Angeles Metropolitan Area in 1962

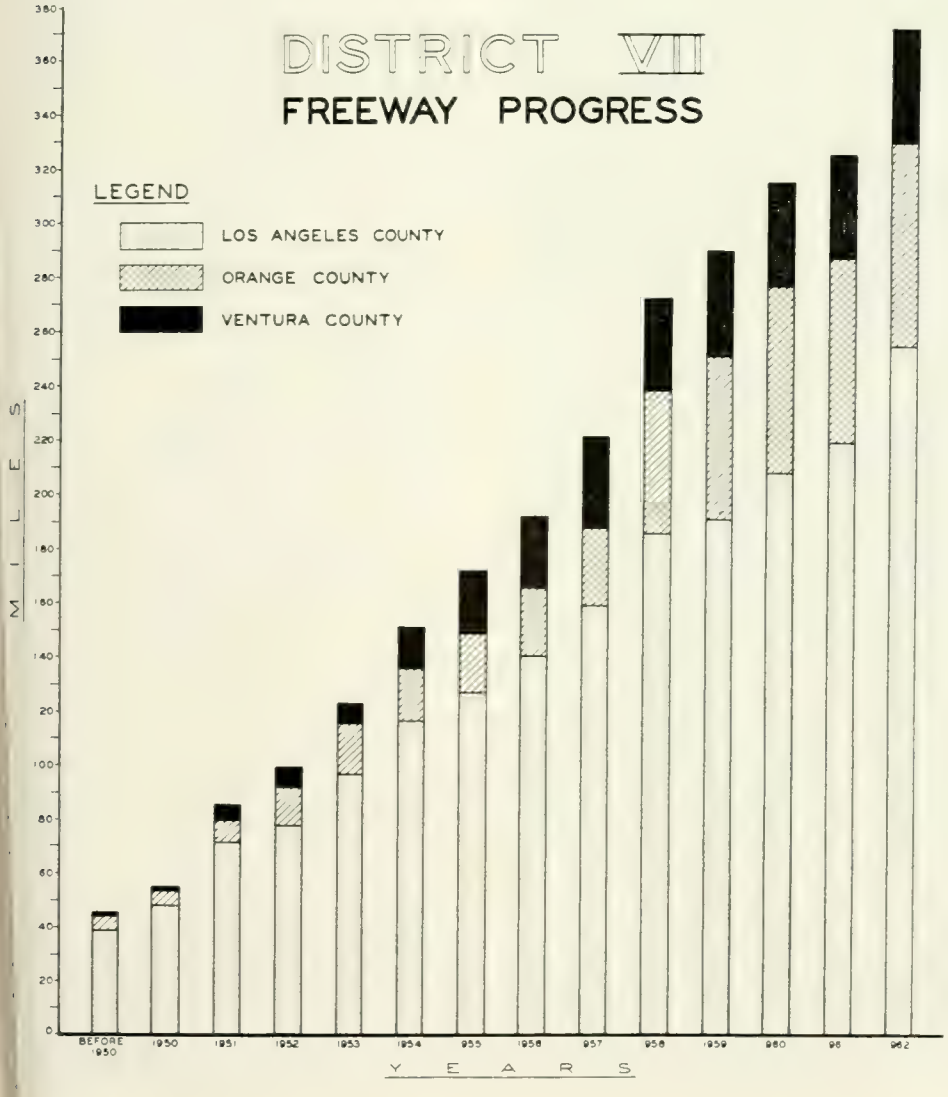
Location	*Persons (per day)*	*Tons of goods (per day)*	*Boxcars*	*Liberty Ships*
Hollywood Freeway				
Vicinity of Glendale Boulevard	300,000	48,000	800	5
San Bernardino Freeway				
Vicinity of Soto Street	240,000	110,000	1,830	11
Santa Ana Freeway				
Vicinity of Indiana	280,000	70,000	1,170	7
Harbor Freeway				
Vicinity of 30th Street	300,000	30,000	500	3



Daily Number of Persons and Tons of Goods Moved at Selected Sites on Various Freeways in and Surrounding the Los Angeles Metropolitan Area in 1962

Location	*Persons (per day)*	*Tons of goods (per day)*	*Miles distant from Los Angeles central business district*
Hollywood Freeway			
Vicinity of Glendale Boulevard	300,000	48,000	1
San Bernardino Freeway			
Vicinity of Soto Street	240,000	110,000	3
Vicinity of Los Angeles-San Bernardino county line	75,000	34,000	33
Vicinity east of Banning (U.S. 60-70-99)	26,000	26,700	85
Santa Ana Freeway			
Vicinity of Indiana Street	280,000	70,000	5
Vicinity of Tustin Avenue	61,500	14,800	34
Harbor Freeway			
Vicinity of 30th Street	300,000	30,000	3
Vicinity of Victoria Street	45,000	6,000	15
Golden State Freeway			
Vicinity of Castaic Junction	22,500	18,000	36
Ventura Freeway			
Vicinity of Moorpark Road	28,000	10,500	40

fic needs. Note the figures for Banning and the Los Angeles-San Bernardino county line, which points are served by the San Bernardino Freeway and lie 85 miles and 33 miles distant from the Los Angeles central business district, respectively.



Trucks

Tonnages of raw and finished products immediately bring to mind the ubiquitous truck.

The economy of the Greater Los Angeles area and indeed of the nation rests heavily on the millions of trucks traveling the highways and freeways, keeping the urbanized population pools supplied with stocks of commodities ranging from cranberries to oil drilling equipment. Again, the trucks are making greater use of the developing freeway-expressway system because of its flexibility, speed and door-to-door service. It is said that if truck traffic were suspended in this area for a period of 72 hours, the economy would be paralyzed.

California's 1,271,299 trucks constitute 12 percent of the total motor vehicle registration. Annually, intrastate for-hire truckers haul 24,500,000 tons of goods in the Southern California Counties of San Diego, Imperial, Riverside, San Bernardino, Orange and Los Angeles. If tonnages were available from private trucking and interstate carriers, this figure would be multiplied many times over. Intrastate trucks serve 1,153 communities and towns, of which 717 depend entirely on trucking for their livelihood.

The more than 500,000 registered trucks in the six-county area outnumber the combined registration of the following commercial and industrial centers outside of California: the five boroughs of New York (New York City), Cook County of Illinois (Chicago), Wayne County of Michigan (Detroit), Philadelphia County of Pennsylvania (Philadelphia), Cuyahoga County of Ohio (Cleveland) and Allegheny County of Pennsylvania (Pittsburgh).

Only Texas and New York State number more truck registrations than these six Southern California counties. Nine and six-tenths percent of all the trucks registered in the United States are registered in California; 4.57 percent of all the trucks registered in the United States are registered in these six counties.

Seattle Public Library



Retouched photo showing the shape of the Santa Monica Freeway at its west terminus in the City of Santa Monica (foreground). The freeway begins to merge with Olympic Boulevard at Lincoln Boulevard (center). It will be in use in 1965.

Freeway Progress

During 1962, 45.6 miles of new freeway were added to the existing freeway system in Ventura, Orange and Los Angeles Counties, at a construction cost of $158,400,000, bringing the grand total of actual miles in operation to 372.

This represents a total obligated investment at the close of the year of $1,300,000,000 since the freeway program was first initiated in 1940.

By coincidence, in 1950 the 6,710 square mile area of District VII had only 45.6 miles of freeway constructed, so that in the relatively short space of a dozen years the system has expanded eightfold. Sound legislative planning and financing at the federal and state levels has been able to achieve more in a single year than had been achieved in the decade preceding 1950.

Construction contracts in progress on freeway and highway projects of all types in 1962, fluctuated from an all-time high of $251,000,000 in February, to a low of $167,000,000 in October, for a monthly average of $209,000,000. There were 161 major and minor contracts awarded and 180 completed.

The California Highway Commission adopted the 1963-64 state highway budget in October 1962. Of $554,600,000 allocated for all state highways in California, $92,493,000 in construction funds, and $71,500,000 in right-of-way funds, went to District VII.

Right-of-Way

For the year 1962 there were 3,151 properties acquired at a total cost of $62,113,940, or an average value per parcel of $19,712. The most active projects, from the standpoint of money expended, included the following:

Freeway	*Amount*
Foothill	$5,400,000
Colorado	9,275,000
San Gabriel River	4,375,000
Pomona	8,000,000
Santa Monica	8,263,000
Artesia	8,915,000

There were 3,252 parcels of property appraised at a value of $77,900,000.

The number of rental accounts, or state-owned property, amounted to 4,942 building units; 1,500 of this number were sold at public auction and removed, and 1,233 units were demolished, leaving a balance of 2,209 units being rented as of January 1, 1963. A total rental income of $2,042,000 was received and returned to the State Highway Fund from these units.

An additional $11,450 per month was collected for the rental of parking areas beneath the Santa Monica Freeway viaduct. California became the first state in the nation to lease parking areas under viaduct structures on interstate routes. Presently, there is available for lease under the Santa Monica Freeway viaduct, an area of 3,500,000 square feet, space sufficient for parking 10,000 automobiles at an estimated annual income of $260,000.

In the course of the year, the district auctioned off, or otherwise sold 300 parcels of excess land, or 131 acres, for the sum of $4,000,000. Additional income was realized through sale of building improvements to be moved from freeway right-of-way; 1,500 such improvements were sold for $1,600,000. Other buildings with a nominal salvage value were demolished at a cost of $527,000, as part of the right-of-way clearance program.

Route Planning

The district has a tentative schedule for the first half of 1963 which estimates that there will be eight district hearings and two commission hearings concerning route locations. There may well be an equal number of hearings in the latter half of 1963.

Projects closest to the public hearing stage are: the Century Freeway, between California Avenue in South Gate and the Los Angeles International Airport; Pacific Coast Freeway, be-

tween the south side of the Los Angeles International Airport and the Marina Freeway; Route 79 Freeway, between the Golden State Freeway and the Antelope Valley Freeway (hearing held March 7, 1963); the Simi Valley Freeway, between De-Soto Avenue and the Foothill Freeway near Hansen Dam; the Beverly Hills Freeway between the San Diego Freeway and the Hollywood Freeway; the Pacific Coast Freeway, serving Oxnard in Ventura County; the Sign Route 126 Freeway, between Santa Paula in Ventura County and the Los Angeles county line; the Simi Valley Freeway in Ventura County, between the Sign Route 126 Freeway near Saticoy and Madera Road east of Moorpark; the Pacific Coast Freeway, between Point Mugu in Ventura County and Malibu Canyon Road in Los Angeles County; the Pacific Coast Freeway in Orange County, between Huntington Beach and the southern limits of the City of Newport Beach (Highway Commission hearing held March 14, 1963); and the Huntington Beach Freeway in Orange County, between Pacific Coast Highway and Chapman Avenue in Stanton.

The year 1962 saw the adoption of 112 miles of freeway having an estimated total cost of $306,000,000, when developed, bringing the district's total of adopted freeway and expressway routes to 809.5 miles, which is 51.4 percent of the California freeway and expressway system within the district.

During 1962, District VII conducted 16 public hearings, and participated in five commission hearings concerning route location. Approximately 100 informal meetings were held with representatives of cities and counties.

At the present time, approximately 365 miles of additional freeway routes are under study with an estimated cost of $2,000,000,000. Expectations are that approximately $300,000,000 of this total will be adopted during 1963.

Bridges

Construction of the Vincent Thomas Bridge between San Pedro and Terminal Island progressed very well in 1962. The substructure contract started in mid-1961 and was completed in July 1962. By the end of the year 60 percent of the superstructure was complete and 90 percent of the work on approaches and toll collection facilities was completed. It is expected that the facility will be open to traffic in October of 1963 with completion of the entire project scheduled for early 1964.

When completed, this graceful suspension bridge will capture the harbor skyline. Its towers rise 365 feet above the water, and the 1,500-foot center span will provide a navigation vertical clearance of 185 feet. The two cables carrying the suspended spans are 13⅞ inches in diameter and each contains over 4,000 individual wires, which, if placed end to end, would extend a distance of 5,000 miles.

The entire structure is supported on piles, which is unique for a suspension bridge. Both beauty and economy in the approach spans and towers were achieved through the employment of the latest welding techniques in fabricating structural steel. The $21,000,000 facility will provide a four-lane traffic link between the proposed Harbor Freeway extension in San Pedro and the southern terminus of the Long Beach Freeway. Both shores of the harbor basins will be easily accessible.

In the construction of other highway facilities in the district area, 186 bridges were built at a total cost of $54,769,729. Some appreciation of the volume of this work can be had by visualizing the quantities of the principal materials used. Over 500,000 cubic yards of structural concrete were required. Incorporated in the concrete were 142,000,000 pounds of reinforcing steel. The amount of structural steel used was 26,870,000 pounds.

Among the principal structures completed during the year was the western end of the Santa Monica Viaduct from Harbor Freeway to Vermont Avenue. Also completed during the year were the Pasadena Freeway-Golden State Freeway interchange structures. The Elysian Viaduct in this interchange, crossing the Los Angeles River, railroad yards, and Pasadena Freeway, contains 11 acres of roadway surface.

By incorporating progressive ideas in the design concepts of freeway structures, it has been possible to furnish facilities considered to be some of the most pleasing in the nation.



Looking east along the completed portion of the Santa Monica Freeway from Vermont Avenue (bottom) toward the Santa Monica-Harbor Freeway interchange (center).

Maintenance

As annual freeway mileages climb and new sections of freeway are landscaped, maintenance costs are proportionately on the increase. Some of these costs for District VII are itemized as follows: Districtwide maintenance costs for fiscal 1961-62 totalled $9,226,504 or $1,492,151 above the previous year. Total costs of repairs to state highways was $240,560, 70 percent of which was recoverable, representing a loss to the State of $72,-494. The loss figure for the 1960-61 budgetary year was $113,567. Construction cost of all types of guardrail and median barrier installed was $747,752 while maintenance and repair costs were $219,736. Maintenance of signals, safety lighting and signing rose from $923,015 in 1960-61 to $1,-098,979 in 1961-62, an increase of 19 percent.

In the five year period ending with the 1961-62 fiscal year, $3,519,927 was spent by state and state-paid city forces in clearing the highways of all kinds of debris. Antilitter laws coupled with stricter enforcement are apparently unable to cope with this senseless waste of public funds.

Functionally planted and fully landscaped freeways, 1,113 acres in all in July 1962, required the expenditure of $1,325,366 as against $1,218,438 in 1960-61.

Construction

Significant in the past year's operations were the many changes experienced in connection with portland cement concrete paving work. Most of the contracts went to the new method of central-mixed concrete, whereby the concrete was mixed at a central mixing plant and transported to the placing site in modified dump type trucks. The slip-form method of paving is now quite common and only one job in the district last year utilized the old style conventional method of single lane paving between headers. Several jobs still paved between headers but on a 24-foot width, using the central-mixed method.

One job in Ventura County, through the City of Ventura, was paved on a monolithic 36-foot width by the slip-form method. Griffith Company was the contractor on the project.

The slip-form technique in paving has now progressed to the point where less and less grinding of the completed surface is needed. One job in Orange County was completed without any grinding whatever. This was the contract on the Newport Freeway through the City of Tustin, completed by the Gordon H. Ball Company.

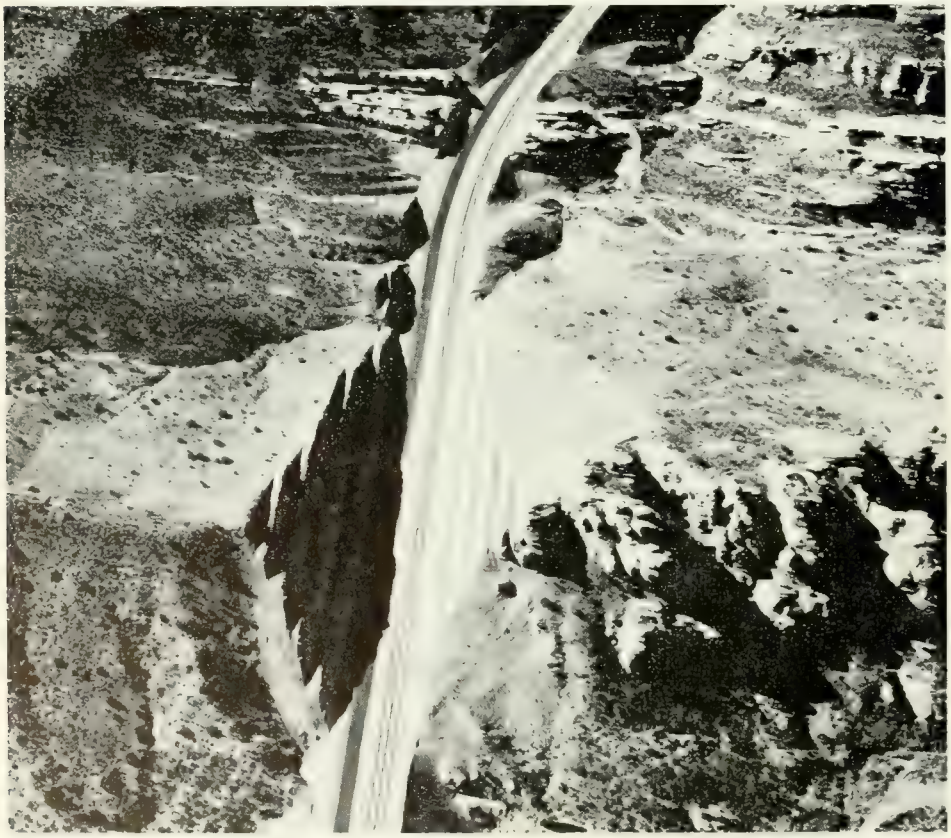
Another new operation connected with paving during the year was inaugurated by the Gordon H. Ball Company on the Sign Route 126 Freeway in Ventura County, whereby the concrete was transported in transitmix trucks with a tilt bed type dump so that a dryer mix could be used in transitmix trucks and dumped therefrom into the slip-form paver.

Also, during the year, 249,200 linear feet of cable chain link barrier fence, and 225,600 feet of metal beam barrier, were installed on freeways at a cost of $2,348,000 for the protection of traffic. At the end of 1962 there were 123 miles of median barrier completed in District VII.

Finally, a changing technique in portland cement concrete indicated a new trend in cases where headers are still being used. They are now placed on top of prepared coment-treated base rather than cement treating between headers as has been done in the past. This new technique is a workable improvement due to better control and finished grade on cement-treated base operations.

Major earth moving operations in the district included a large grading job on the Antelope Valley Freeway in north Los Angeles County. Grading was also completed on the 13,000-000-cubic-yard project on the San Diego Freeway section through the Santa Monica Mountains in West Los Angeles.

A slide situation which developed on the Ventura Freeway project westerly of the City of Ventura was corrected by laying back the slopes, and this grading job was nearing completion at the end of the calendar year. The slopes were further stabilized by anchoring wire mesh on the slope



The famed Vasquez Rocks area where the early California bandit, Tiburcio Vasquez, is said to have holed up. The Antelope Valley Freeway is under construction here at Escondido Canyon and will be completed this year.

faces to retain rolling boulders from crashing to the roadway below.

On the major contracts in District VII during the calendar year, major dirt-moving operations amounted to 33,200,000 cubic yards, representing a cost of over $16 million.

Antelope Valley Freeway

The Antelope Valley Freeway, US 6, has been adopted by the California Highway Commission for its entire 54.5-mile length, beginning at the Golden State Freeway just north of the City of San Fernando to the Kern county line, approximately eight miles north of the community of Lancaster.

The freeway is to be constructed throughout its length for four lanes, the exceptions being where passing lanes are required due to sustained grades. The design includes features for expansion to six and eight lanes as future traffic requires.

Construction began in December of 1960 on a 10-mile section beginning east of Solamint Junction to Escondido Canyon Road and was completed in October of 1962. The construction consisted of drainage, one bridge structure, frontage roads and freeway grading, costing a little over $7,000,000. In October of 1961, a second contract was let for approximately $6,200,000 to pave these 10 miles and to grade, pave, and construct 10 bridges for an additional six miles to Ward Road. It is expected that this





PHOTO ABOVE. Motorist in distress uses emergency call box to summon aid. BELOW. The Santa Monica Freeway viaduct completed last year performs dual service for motor vehicles traveling on top and parked below. The State has been leasing parking space under the four-mile-long structure.



Looking north along the recently completed San Diego Freeway through the Santa Monica Mountains with the Mulholland Bridge spanning the freeway.



The San Diego Freeway at the Long Beach Freeway Interchange and the Los Angeles River. This section is under construction to California Avenue in Signal Hill and will be completed in December.

project will be complete in the fall of this year.

Plans for an eight-mile segment of the freeway have been completed from Ward Road interchange to Angeles Forest Highway. This section is financed with an item of $5,300,000 in the 1963-64 fiscal year construction budget. The project includes grading, paving and seven bridge structures.

Artesia Freeway

The Artesia Freeway, State Sign Route 14, will when completed extend 21.6 miles from the San Diego Freeway to the Santa Ana Freeway. The six- and eight-lane facility, estimated to cost $83,000,000 for rights-of-way and construction, is being designed in six units. The individual units, with mileages and construction cost estimates, follow from west to east: Normandie Avenue to Alameda Street, 4.5 miles, $6,800,000; Alameda Avenue to Lakewood Boulevard, 4.8 miles, $18,000,000; Lakewood Boulevard to Studebaker Road, 2.7 miles, $5,800,000; Studebaker Road to Valley View Avenue, 4.5 miles, $9,000,000; Valley View Avenue to Beach Boulevard, 2 miles, $3,500,000; and Beach Boulevard to Santa Ana Freeway, 1 mile, $4,000,000. The earliest construction on the Artesia Freeway is expected on the Lakewood Boulevard-Valley View Avenue segment, with the balance of the route following. Route location studies for this freeway west from Normandie Avenue to its ultimate connection with the San Diego Freeway have not yet been initiated.

Colorado Freeway

The Colorado Freeway, State Sign Route 134, is an easterly extension of the Ventura Freeway from the Golden State Freeway to the Foothill Freeway. A portion of this route between Avenue 64 in Los Angeles and Holly Street in Pasadena was constructed to four- and six-lane standards some years ago (and is being considered for future widening). The 6.6-mile segment between the Golden State Freeway and the existing constructed route is being planned as an eight-lane facility, passing through Glendale and Eagle Rock. Cost of the entire route will be approximately $79,000,000 for rights-of-way and construction.

Corona del Mar Freeway

The Corona del Mar Freeway extends seven miles between Pacific Coast Highway and the San Diego Freeway in Orange County. It will originally be a six-lane facility with provision for an ultimate eight lanes. Design is in initial stages and future construction and right-of-way costs will approach the $17,500,000 mark.

Foothill Freeway

The Foothill Freeway (Interstate 210) extends from the Golden State Freeway north of the City of San Fernando and more or less parallels Foothill Boulevard across Los Angeles County to the San Bernardino county line, a distance of 52.7 miles. Portions of this route have been adopted, notably from the Golden State Freeway to Foothill Place at Hansen Dam and from Michillinda Avenue in Arcadia to the San Bernardino county line in Pomona. These portions are now in active design and together measure almost 40 miles.

The balance of the route, with the exception of a two-mile link previously constructed between Hampton Road and Montana Street, is being studied for future adoption. These studies are being made between Pasadena on the south and Hansen Dam on the north, a distance of 11 miles. When fully completed the Foothill Freeway will represent a right-of-way and construction investment of some $243,600,000.

The Foothill Freeway is being designed in several sections: Golden State Freeway to Foothill Place, 9.4 miles, with a construction cost estimate of $13,340,000; Colorado Freeway to Michillinda Avenue, 5.3 miles, with a construction cost estimate of $18,300,000; and Michillinda Avenue to the San Bernardino county line, 21.6 miles, with a construction cost estimate of $52,300,000.

Garden Grove Freeway

The Garden Grove Freeway, State Sign Route 22, connects the Pacific Coast Highway in Los Angeles County with the Newport Freeway in Orange County, a distance of some 15 miles.

Two stage construction projects, anticipating full freeway development, were completed in 1959 and 1961 between Los Cerritos Channel and Knott Avenue, and between Studebaker Road and the San Diego Freeway, at a combined cost of $1,773,000.



Construction on the San Diego Freeway north of the Imperial Boulevard interchange (foreground). Three jobs now under construction will complete the freeway from Hawthorne Boulevard to Jefferson Boulevard by mid-1963.

Work is now in progress at the interchange of the Garden Grove, Santa Ana and Orange Freeways, under two contracts worth $10,821,100 which will be completed in the summer of 1964. Another contract is underway between Knott Avenue and Newland Street, 1.8 miles, at a cost of $3,744,800 and will be completed by mid-1964.

Financing is available for continuing construction this year from the San Diego Freeway to a point east of Bolsa Chica Road. This project will include work on the San Diego Freeway, as well, and $8,350,000 has been allocated for both projects. Another $1,400,000 is budgeted for freeway construction between Haster Street and Garden Grove Boulevard and Placentia in Orange, a distance of one mile.

The remaining portions of the freeway are being designed, looking toward early completion of the route between the San Diego and Santa Ana Freeways. Total cost of the Garden Grove Freeway is estimated at $47,573,000.

Glendale Freeway

The Glendale Freeway, State Sign Route 2, 9.5 miles in total length, is completed from Glendale Boulevard at Duane Street to Fletcher Drive near Avenue 36. This 2.4-mile link was built at a cost of $8,100,000 under three separate contracts, the last of which, from Riverside Drive to Glendale Boulevard, was opened to traffic in March, 1962.

On August 23, 1962, the California Highway Commission adopted the freeway northerly of Avenue 36 to Verdugo Boulevard, 6.3 miles. Design studies are underway on this section,

which is estimated to cost $22,400,000 for construction.

The route for the connecting link of the Glendale Freeway between the Hollywood Freeway at Vermont Avenue and the southerly end of the constructed Glendale Freeway at Glendale Boulevard, was adopted by the California Highway Commission on January 23, 1963. The length of the newly adopted section is 2.7 miles, with an estimated construction cost of $12,000,000. Included in this portion of eight-lane freeway is an interchange with the Hollywood Freeway that will require extensive revision of the existing Hollywood Freeway from Virgil Avenue to Normandie Avenue.

Golden State Freeway

The Golden State Freeway, U.S. 99 (Interstate 5) begins at the East Los Angeles Interchange at Seventh and Soto Streets in Los Angeles and continues for more than 73 miles as freeway-expressway to the Kern county line, where it enters District VI.

During 1962 the route was pushed to completion to full freeway standards from Pasadena Avenue to Glendale Boulevard, filling in the missing link between jobs completed on the south and on the north. This was accomplished at a construction cost of almost $19,000,000.

On January 15, 1963, the Lankershim Boulevard-Osborne Street extension, 2.4 miles, was added at a cost of $4,739,000, making the route continuous from the East Los Angeles Interchange to Osborne Street in the Sun Valley area.

At present a single 5.6-mile, $13,383,600 contract remains to be completed from Osborne Street to the San Diego Freeway north of San Fernando (together with a portion of the San Diego Freeway), and the route will be complete throughout. It is expected that traffic will be using this last segment by the fall of 1963.

Plans are in the making for conversion of the Golden State route to full freeway standards from San Fernando Road to the Kern county line. It is now an expressway. The first conversion project will go to contract this year from $5,950,000 in funds available in the 1963-64 construction budget. The project will provide three miles of eight-lane freeway in the Castaic area and will also add almost a mile to the intersecting Sign Route 126 Freeway on the west.

Other conversion projects under design and construction are planned progressively in ensuing years. Design includes conversion of the existing highway along the five-mile grade northerly of Castaic to one direction of travel, with construction of a new roadway for the opposite direction of travel. From Paradise Ranch to the State Highway Maintenance Station, about 11 miles, the freeway will be located east of the present expressway section.



The last link of the Harbor Freeway was completed in 1962. The view is toward the harbor area and the San Pedro-Terminal Island Bridge.

Harbor Freeway

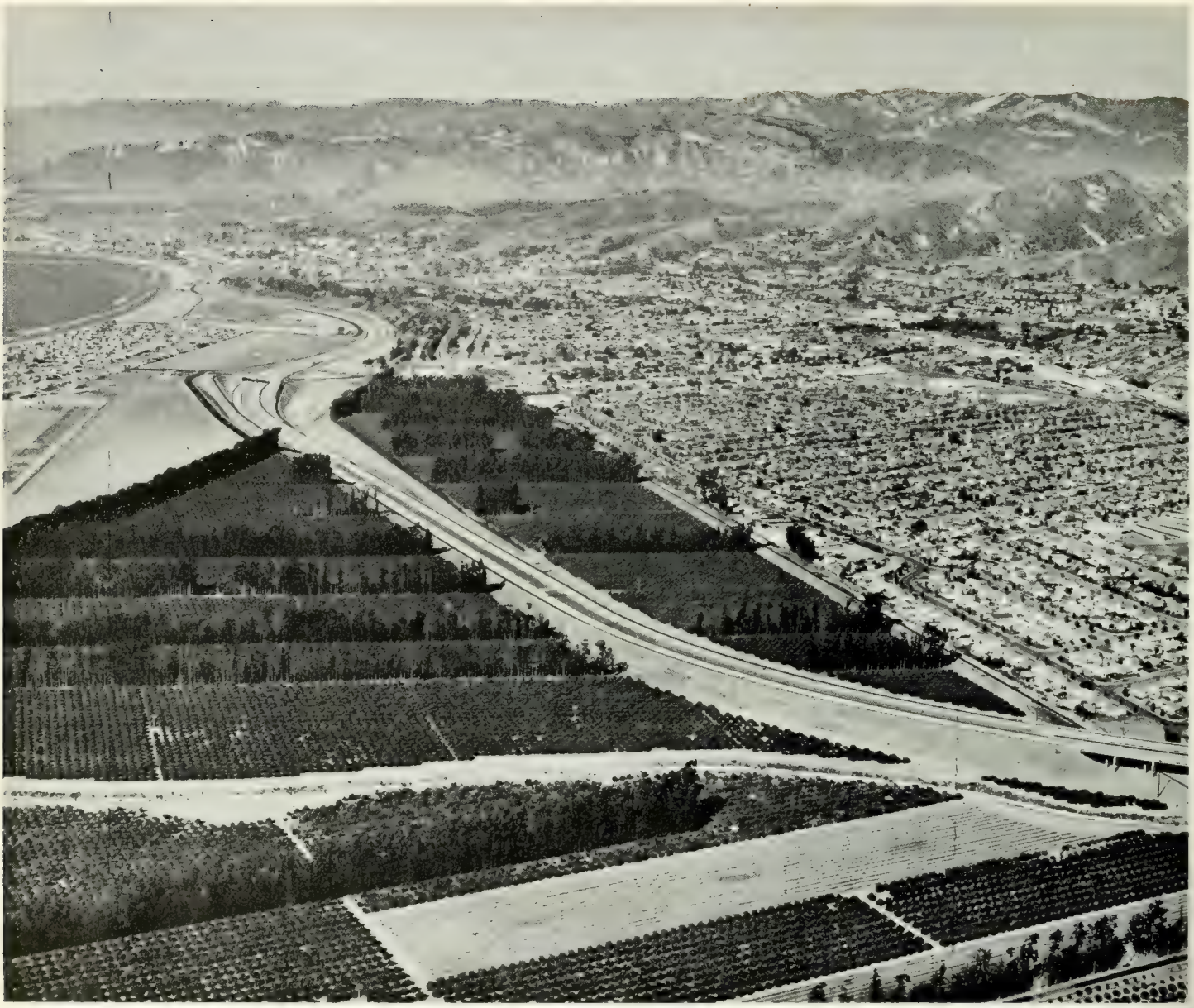
The Harbor Freeway, State Sign Route 11-U.S. 6, was completed throughout in 1962, with the opening to traffic of a four-mile, $6,035,000 project between 208th Street and Pacific Coast Highway on October 2. It is now open between the four-level structure in the Los Angeles Civic Center and Battery Street in San Pedro, 22 miles. A total of $104,590,000 has been expended on this route to date.

Further improvements of the Harbor Freeway are in the planning stage. These include widening of the freeway to six lanes for 2.3 miles between Pacific Coast Highway and Battery Street, estimated to cost $660,000; and extending the freeway one mile from Battery Street to Elberon Avenue, a route for which was adopted by the California Highway Commission in May, 1960, at an estimated construction cost of $2,700,000.

The Route 167 Freeway-Seaside Freeway, State Sign Route 15, is related to Harbor Freeway development. It is an adopted route between the Harbor Freeway and Harbor Boule-



The Golden State Freeway reaches into the San Fernando Valley. This portion, to Osborne Street, was opened to traffic in January.



Orchard and ocean flank the completed section of the Ventura Freeway in the City of Ventura. The view is westward.

vard and will provide access to the Terminal Island Bridge now under construction. The 0.6-mile link will cost about $1,300,000 to build.

The foregoing improvements of the Harbor Freeway and Seaside Freeway are among many projects awaiting financing in District VII, and construction hinges on the future availability of funds.

Hollywood Freeway

The Hollywood Freeway, U.S. 6, was extended 0.7-mile between Vineland Avenue and Magnolia Boulevard in North Hollywood, on July 16, 1962 with traffic using it as far as Magnolia Boulevard. Completion of the $2,815,000 project made the route 11.6 miles long from Spring Street in downtown Los Angeles to the temporary terminus at Chandler Boulevard, bringing the total cost of right-of-way and construction to $74,-149,000.

Six miles of the Hollywood Freeway are being designed to a junction with the Golden State Freeway at Truesdale Street. Estimated to cost $15,572,000 for construction, these projects may be financed in the near future.

An existing six-lane section of the Hollywood Freeway in Hollywood, now carrying 140,000 vehicles per day, is being considered for widening from Sunset Boulevard to Pilgrimage Bridge, two miles. The project will cost an estimated $4,700,000 for right-of-way and construction. Adding a lane in each direction and widening the bridge structures will make the freeway a uniform eight lanes from the Los Angeles Civic Center to the San Fernando Valley.

Traffic flow on the Hollywood Freeway has already been facilitated through construction of the Golden State Freeway, a paralleling alternate route to the east and referred to as the downtown freeway loop.

Long Beach Freeway

The Long Beach Freeway, State Sign Route 15, is completed as a state highway from Pacific Coast Highway in Long Beach to the San Bernardino Freeway near Alhambra, 19.7 miles. The total obligated cost of the freeway at the close of 1962 was $56,524,000.

North of the San Bernardino Freeway $3,400,000 is budgeted for construction to Valley Boulevard, a distance of one mile. From Valley Boulevard the freeway route is adopted to Huntington Drive, from which point it is under study for seven miles to a junction with the Foothill Freeway. Studies on this northernmost section will be concluded in 1964 at which time public hearings will be held.

Widening improvements on the previously constructed route of the Long Beach Freeway from Rosecrans Avenue to the Santa Ana Freeway, and from Rosecrans Avenue to the San Diego Freeway, are being planned. The freeway will be widened from six to eight lanes for the 13-mile length and will require the expenditure of some $4,500,000.

Marina Freeway

The route of the Marina Freeway was adopted by the California Highway Commission on December 16, 1959. The 2.6-mile link will connect the San Diego Freeway with Lincoln Boulevard in the Culver City area and interchange with the Pacific Coast Freeway in the vicinity of Marina del Rey. The easterly continuation of this route is referred to as the Slauson Freeway, which is now under study.

Preliminary design has begun on the Marina Freeway and $1,794,000 has been expended on the needed right-of-way. The estimated construction and right-of-way cost will be in excess of $17,000,000.

Newport Freeway

The Newport Freeway, State Sign Route 55, is 17.7 miles long from the Pacific Coast Highway to the Riverside Freeway in Orange County. Two contracts totalling $9,082,000, and 6.6 miles, were completed and opened to traffic in 1962 joining the Santa Ana Freeway with the Riverside Freeway. South of the Santa Ana Freeway, two miles of the Newport route is financed to Warner Avenue and construction on the $2,137,500 project will begin soon. Construction plans are being readied between Warner Avenue in Santa Ana and 19th Street in Newport Beach, 6.5 miles, with an estimated construction cost of $7,600,000.

Ojai Freeway

The Ojai Freeway, U.S. 399, begins at the Ventura Freeway in Ventura and continues to the Santa Barbara county line, 57 miles distant. Development of the route at this time centers about the southerly end where a section is under construction between the Ventura Freeway and Prospect Avenue, 0.3-mile, in connection with the Ventura Freeway, which will be opened to traffic in June 1963. The freeway was completed from Prospect Street to Mills School, in 1956, 3.6 miles, at a construction cost of $1,736,000.

The route has been adopted from Mills School to Cozy Dell Canyon, northwest of Ojai, 11 miles, and is now under active design. The construction cost estimate for this mileage is $12,700,000.

PHOTO BELOW LEFT. An eastward view of the Ventura Freeway in Toluca Lake from Pass Avenue overcrossing (bottom left). Upper right, Griffith Park. PHOTO BELOW RIGHT. Looking easterly at construction in progress on the Sign Route 126 freeway from Victoria Avenue Overcrossing at Ventura city limits. Project has recently been opened to traffic as far as Mills Road.





Orange Freeway

The Orange Freeway (State Sign Route 57) is adopted in Orange and Los Angeles Counties, from the Santa Ana Freeway on the south to the San Bernardino Freeway on the north, 19.8 miles. When the route is ultimately extended to a junction with the Pacific Coast Highway at Huntington Beach, it will total nearly 31 miles and will cost about $122,000,000.

The only project under construction at this time on the Orange Freeway is at the Orange-Santa Ana-Garden Grove Freeway Interchange, where two contracts worth almost $11,000,000 will be completed in the summer of 1964.

Pacific Coast Freeway

Route location studies on the Malibu unit of the Pacific Coast Freeway (U.S. 101 Alternate) have been completed. Study data are in the hands of the State Highway Engineer, who will make a recommendation to the California Highway Commission pending re-evaluation of the studies in the light of scenic highway needs, in the near future.

The freeway is described as extending from Malibu Canyon Road to Point Mugu, a distance of 22.5 miles. There were nine basic lines with variants under consideration, and the estimated cost curve, between the most economical line and the most expensive, ranges from $30,000,000 to $150,000,000, including rights-of-way and construction. Freeway studies in the area first began in 1958.

The most interesting feature of studies on the Malibu Canyon Road-Santa Monica unit of the Pacific Coast Freeway, measuring 12 miles, is the marine location concept being explored by the U.S. Army Corps of Engineers under a $135,000 contract to the State. These explorations will be completed in May 1963, at which time a report will be submitted setting forth the results.

The corps has been examining the ocean floor and underlying bedrocks, including wave action peculiar to Santa Monica Bay. The corps study is along the lines of two concepts: (1) a marine location at distances of one-half to one mile from the shore, on causeway (bridge) or solid fill, with recreational facilities, seaward and inland beaches and parking facilities. This plan would extend over the entire 12 miles or sections thereof. (2) A shore location, with widening of the existing beach from 400 to 1,500 feet, including freeway connections to parking areas and other facilities.

The district is studying a third concept, a conventional location inland of the existing highway. The ultimate plan could contain elements of each of the three concepts.

Route location studies are in progress for almost the entire length of the Pacific Coast Freeway from El Rio in Ventura County to the vicinity of San Juan Capistrano in Orange County, about 112 miles. Public hearings leading to adoption will be scheduled as study data are developed. The freeway is constructed for 6.8 miles in Ventura County between Calleguas Creek and Date Street in Oxnard at a cost of $2,413,000. Nineteen miles of the route are adopted in Ventura County and 5.4 miles in Orange County.



The Dodger Stadium (left) is now served by new pedestrian and vehicular connections at the Pasadena Freeway (foreground). Baseball games last year attracted 4,500,000 people in 1,250,000 automobiles.

Pomona Freeway

The Pomona Freeway, U.S. 60, begins at the East Los Angeles Interchange and continues for almost 30 miles to the San Bernardino county line in this district. Completion of this route will require the expenditure of approximately $93,000,000 in right-of-way and construction funds.

Construction of the first unit of the Pomona Freeway is included in the 1963-64 fiscal year budget, with an allocation of $8,400,000. This 2.4-mile project will extend easterly from the East Los Angeles Interchange to Third Street near Downey Road, and will provide an eight-lane freeway.

Design work is progressing for the easterly extension of the Pomona Freeway in order that construction

may be started as funds become available. The freeway will include interchanges with the Long Beach Freeway in the Belvedere Park area, the San Gabriel River Freeway near the confluence of the San Gabriel River and San Jose Creek channels, and the Huntington Beach and Orange Freeways.

Riverside Freeway

The Riverside Freeway, State Sign Route 14-18 and U.S. 91, has been constructed throughout as freeway and expressway from the Santa Ana Freeway to the Riverside county line, 19 miles. So far, $15,179,000 has been invested in the development of this route and plans are afoot to convert the existing expressway portions to full freeway, with the first project being readied between Placentia Avenue and the Newport Freeway, 3.7 miles.

San Bernardino Freeway

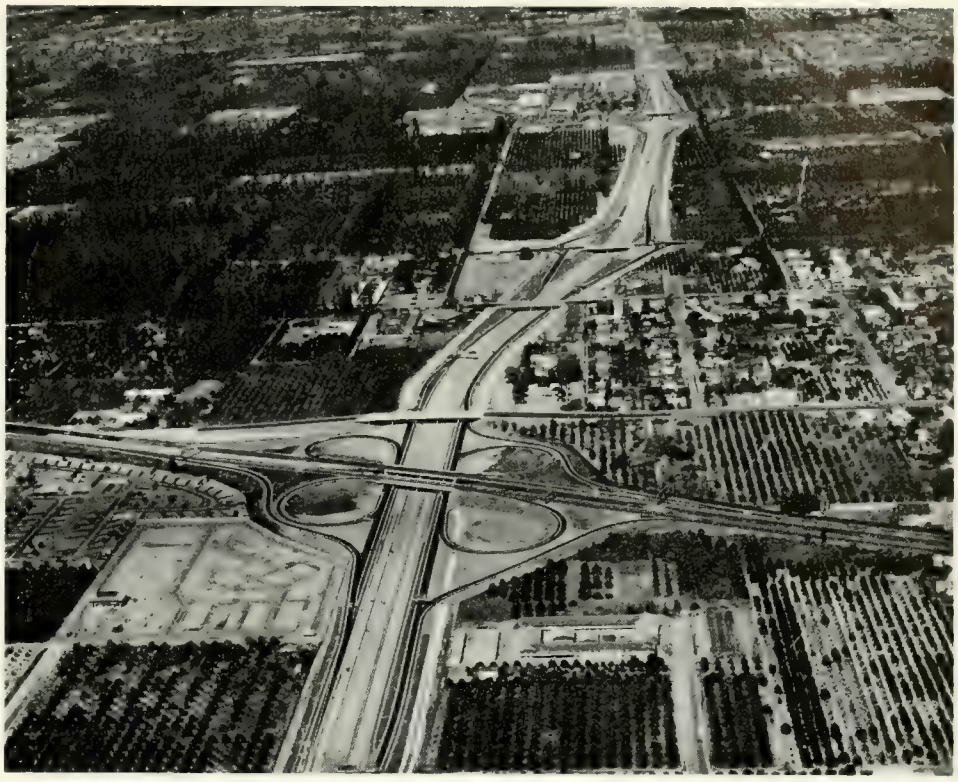
The San Bernardino Freeway, U.S. 60-70-99 (Interstate 10), 30.5 miles in length, has been in service for a number of years between the Santa Ana Freeway at Los Angeles River and the San Bernardino county line.

About $63,538,000 has been obligated on this heavily travelled route so far, including widening projects at several locations which have added additional traffic lanes: San Dimas Avenue to San Bernardino county line, $1,033,000 completed in 1960; Rosemead Boulevard to Puente Avenue, $1,319,000 completed in 1961; vicinity of Golden State Freeway interchange, $800,000 completed in 1961; Eastern Avenue to Rosemead Boulevard, $2,025,000 completed in 1961; and Holt Avenue to San Dimas Avenue, $902,000 completed in 1962.

One more widening project is planned between the Golden State Freeway and the Long Beach Freeway and will cost an estimated $9,000,000.

San Diego Freeway

The San Diego Freeway (Interstate 5 and 405) stretches 93.6 miles in District VII, between the San Diego county line at San Clemente and the Golden State Freeway north of San Fernando in Los Angeles County. The year 1962 was significant for the number of completed miles added to this route: Valley Vista Street to Casiano Road across the Santa Monica Mountains, 5.7 miles, $20,150,000, opened to traffic on December 21, 1962; Hawthorne Boulevard to the Harbor Freeway (two contracts), $10,912,000, 4.5 miles, opened to traffic on August 29, 1962; Harbor Freeway to Alameda Street (two contracts), $11,525,000, 4.6 miles, opened to traffic on July 16, 1962; and Alameda Street to Long Beach Freeway, $5,129,000, 1.1 miles, opened to traffic on January 25, 1962.



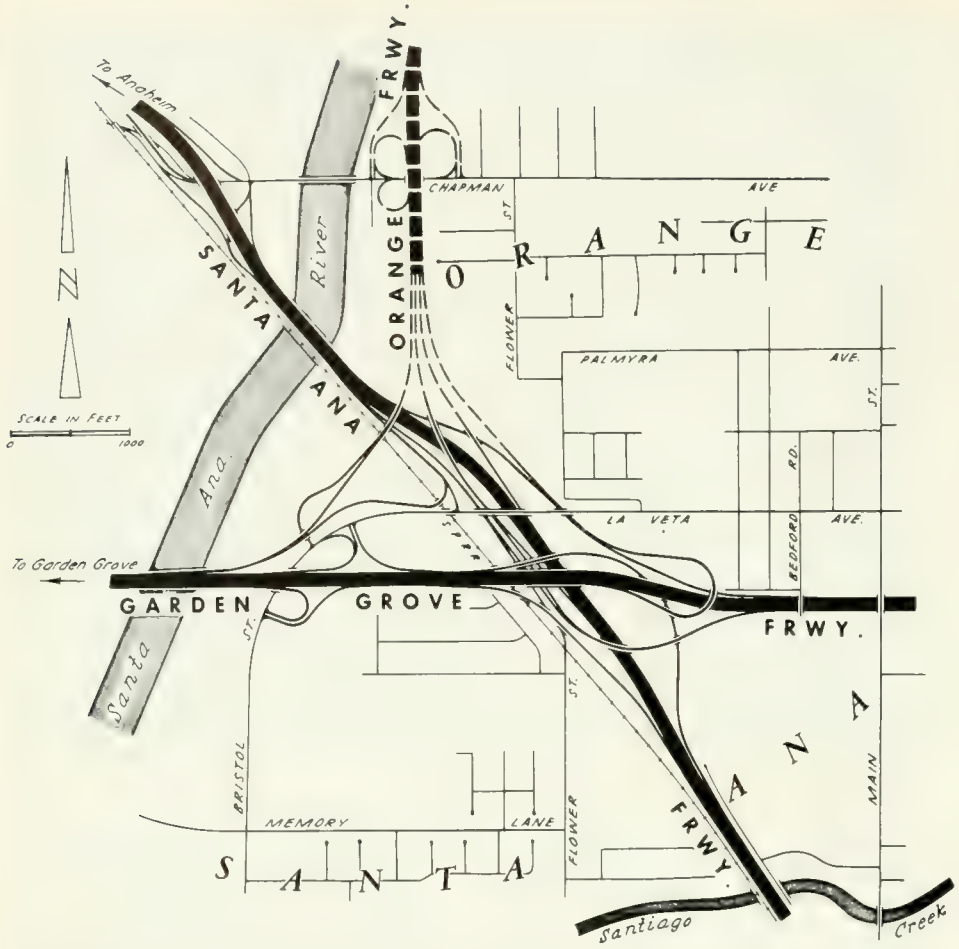
Looking north along the completed Newport Freeway from the Santa Ana Freeway (foreground). New link, opened in September 1962, links Santa Ana with Riverside Freeway in Orange County.

At the close of the year other contracts on intervening sections were underway: Golden State Freeway to Nordhoff Street, $3,234,000, 3.9 miles, and an adjacent section, from Nordhoff Street to Burbank Boulevard, $5,005,000, 4.5 miles, both sections opened to traffic April 19, 1963; Jefferson Boulevard to La Tijera Boulevard, $3,276,000, 1.6 miles, estimated opening to traffic May 1963; La Tijera Boulevard to 137th Street, $11,576,000, 4.7 miles, estimated opening to traffic May 1963; 135th Street to Hawthorne Boulevard, $4,435,000, two miles, dedicated and opened to traffic early in April of 1963; Long Beach Freeway to California Avenue, $7,820,000, 1.6 miles, estimated opening to traffic December 1963, and Atlantic Avenue to the Orange county line, $11,875,000, 5.7 miles, estimated opening to traffic summer, 1964.

There were also other bridge and structure contracts underway along various sections of the route, part of stage construction preparatory to full freeway development.

The construction budget of the past and present fiscal years allocates $17,250,000 for nine miles more of the San Diego Freeway from the San Gabriel River Freeway to Newland Street in Westminster and Huntington Beach. These two projects will be underway this year,

The remaining unconstructed portions of the San Diego Freeway in Orange County are in design. Three projects will carry construction as far as the Santa Ana Freeway at El Toro, a distance of 17 miles, at an estimated construction cost of $33,000,000. In addition, the existing freeway from Capistrano Beach to El Toro is scheduled to be widened to six lanes.



The design plan of the Garden Grove-Santa Ana-Orange Freeway interchange. (See photo next page).

San Gabriel River Freeway

The San Gabriel River Freeway, State Sign Route 35 (Interstate 605), is presently adopted between the Foothill Freeway and the Garden Drove Freeway in Orange County, a distance of 28 miles.

One project on the San Gabriel River Freeway has been completed at Peck Road, under $649,000 contract, providing facilities for the interchange of traffic between the existing San Gabriel River Parkway and Peck Road and connects Peck Road with Workman Mill Road. Elsewhere the freeway is under construction under two contracts worth nearly $11,000,000 for seven miles between Whittier Boulevard and the San Bernardino Freeway. Both contracts will be completed in 1964.

The 1963-64 highway budget includes additional construction financing, $24,750,000, to continue the freeway south to 166th Street in Dairy Valley, more than eight miles. Also financed is a 2.4-mile link in Orange County, between Katella Avenue and the San Diego Freeway, the budget item for which is $5,500,000. A $650,000 item in the current budget will build overcrossings and approach roadways at Centralia Road and at 195th Street, in advance of future freeway construction. All of the foregoing projects will go to construction in 1963.

Contract plans are now being prepared for the 5.3-mile section of the San Gabriel River Freeway from 166th Street to the Orange County line, estimated to cost $13,650,000. Also being planned are connections to the Garden Grove Freeway, 0.7-mile, which will cost about $1,250,000.

On the north end of the freeway, design is progressing between the San Bernardino Freeway and the Foothill Freeway, 5.4 miles. Construction will cost an estimated $14,200,000.

Santa Ana Freeway

The Santa Ana Freeway, U.S. 101 (Interstate 5), is 42.8 miles long from Spring Street in Los Angeles to the San Diego Freeway at El Toro in Orange County. Investments in this route as of December 31, 1962, were $83,348,000.

A widening project was completed in 1962 between South Street and Santa Ana River in the Santa Ana area at a cost of $1,336,000. Other widening projects are planned between Main Street in Santa Ana and Laguna Canyon Road, 10 miles, and between Laguna Canyon Road and the future San Diego Freeway, two miles. The former project (in two units) is budgeted $2,900,000 in the present fiscal year and the latter, estimated to cost $350,000, is awaiting financing.

Median barriers were installed on the freeway between the Harbor Freeway in Los Angeles and Grand Avenue in Santa Ana, costing $731,000; and the Santa Ana Freeway portion of the Newport Freeway was constructed for $356,000.

Under construction at the present time, under two contracts totaling almost $11,000,000, is the Santa Ana-Orange-Garden Grove Freeway interchange, which will be completed in 1964.

Santa Monica Freeway

The Santa Monica Freeway, State Sign Route 26 (Interstate 10), measures 17 miles from the East Los Angeles interchange to the Pacific Coast Highway in Santa Monica. Last year three contracts worth $21,823,000 were completed and opened to traffic, extending the four-mile long Santa Monica Freeway viaduct to Vermont Avenue.

Early in 1963 five more contracts valued at $26,750,600 were in force as far west as La Cienega Boulevard, including the Santa Monica-San Diego Freeway interchange. Two final construction projects were to be advertised soon, filling in the gaps between La Cienega Boulevard and Overland Avenue, 2.6 miles, $6,731,500, and between Sawtelle Boulevard and Ocean Avenue, 3.7 miles, $7,500,000.

It is expected that the Santa Monica Freeway will be opened to traffic to the San Diego Freeway late in 1964

and into Santa Monica by the end of 1965.

Simi Valley Freeway

The Simi Valley Freeway, State Sign Route 118, begins at State Sign Route 126 near Saticoy and proceeds easterly across Ventura County to connection with the Foothill Freeway in Los Angeles County, a distance of some 47 miles.

A 12.5-mile portion of the route between Los Angeles Avenue at Madera Road in Ventura County and De Soto Avenue in the City of Los Angeles was adopted by the California Highway Commission last year. The remaining portions to the west and to the east of this adopted segment are currently under planning study with a target date for adoption late this year.

First construction is planned for a five-mile unit of the adopted route between the easternmost end of Simi Valley and De Soto Avenue in the West San Fernando Valley. An estimated $12,000,000 will be necessary to finance this construction.

Ventura Freeway

The Ventura Freeway, U.S. 101, is constructed to freeway and expressway standards from the Golden State Freeway at Griffith Park in Los Angeles to Palm Street in the City of Ventura.

Two important openings during 1962 made the route continuous from the Hollywood Freeway to the Golden State Freeway. These were projects between the Hollywood Freeway and Buena Vista Street, and between Buena Vista Street and the Golden State Freeway, five miles, completed at a combined construction cost of $10,436,000.

A third project was completed and opened to traffic in the City of Ventura, from Telephone Road to Palm Street, 4.5 miles, at a cost of $9,248,000. A major project is still under $7,757,400 contract, including connections to the Ojai Freeway, and will carry the freeway west from Palm Street to the Ventura overhead, 2.7 miles. This link is set for June 1963 completion.

From the Los Angeles city limits to Conejo Summit, the Ventura Freeway is being initially converted from a four-lane expressway to a four-lane freeway by the construction of interchanges. Six-, and ultimate eight-lane development, will follow as funds become available.

The most recent bridge structures completed are the following: Las Virgenes Road, $493,000; Borchard Road to Conejo Grade Summit, $587,000; Moorpark Road Interchange and improvements of Moorpark, $1,574,884. Projects under contract and scheduled for 1963 completion were Geneve Street Interchange, $432,300 and Chesebro - Lewis Road Interchange, $529,300.

Budgeted interchanges ready for construction are from Los Angeles city limits to Las Virgenes Canyon Road, $1,200,000; Las Virgenes Canyon Road to Chesebro Road, $690,000; Triunfo Road to Moorpark Road, $675,000; Moorpark Road to Borchard Road, $750,000; Old Conejo Road, $470,000; Los Angeles county line to Triunfo Road, $515,000; Lewis Road to Kanan Drive, $620,000; and Vineyard Avenue to Wood Road, $1,054,000.

From the Ventura Overhead at Emma Woods State Park to a point south of the Santa Barbara county line, 10 miles of the Ventura Freeway are in design stages. The freeway here is estimated to cost $1,515,000 for right-of-way and $9,000,000 for construction and will be programmed in future fiscal years.

(For details on the Ventura Freeway and other freeways in Ventura County, see "Ventura County Freeways," *California Highways and Public Works*, September-October 1962).

Route 126 Freeway

The Sign Route 126 Freeway will be a 51-mile route originating at the Ventura Freeway in Ventura and terminating at the Antelope Valley Freeway near Solamint in Los Angeles County. On the westerly end the freeway was dedicated and opened to traffic in mid-April 1963. The section



Looking east along construction on the Garden Grove-Santa Ana-Orange Freeway interchange. The Garden Grove Freeway bridging the Santa Ana River is in the foreground. The diagonal roadway at top is the existing Santa Ana Freeway. (See plan previous page.)

extends from the Ventura Freeway to Wells Road, five miles, and has been under $4,158,950 contract. Construction is about to start on the next link from Wells Road to Santa Paula, 8.5 miles, at a cost of $7,200,000.

The Sign Route 126 Freeway is under study for possible adoption in 1964 from Santa Paula to the Los Angeles county line, 22 miles. From the county line the route is adopted to the Golden State Freeway and a small segment will be constructed at the Golden State Freeway interchange this year.

A public hearing was held on the easterly 10-mile section from the Golden State Freeway to the Antelope Valley Freeway on March 7, 1963 preparatory to route adoption.

Other Freeways

The Yorba Linda Freeway in Orange County, 2.3 miles, was opened to traffic on February 8, 1962, at a construction cost of $1,242,000.

On the Pasadena Freeway in Los Angeles, pedestrian and vehicular connections to the Dodger Stadium were completed at a total cost of $2,257,000.

Industrial and Slauson Freeway route location studies were initiated at the beginning of 1963, and studies on the Beverly Hills and Century Freeways were nearing completion for public hearings by midyear. Studies were also underway on the Malibu-Whitnall Freeway, anticipating adoption after public hearings sometime in 1964.

Transportation Study

Hand in hand with the planning, design and construction of the California freeway-expressway system, the Division of Highways is co-ordinating the Los Angeles Regional Transportation Study. This study was begun in January 1960 and has been described by Highway Transportation Agency Administrator Robert Bradford as perhaps the largest scale major co-operative state-local transportation study ever conceived.

The LARTS study is being conducted under the general co-ordination of the Division of Highways with the co-operation of the U.S. Bureau of Public Roads, the U.S. Housing and Home Finance Agency, the five Counties of Ventura, Los Angeles, Orange, San Bernardino, and Riverside, and 116 cities in these counties. It was organized along the same lines as other successful state-local studies by operating with an advisory committee of local officials from public and private agencies.



Looking north from above the Peck Road Interchange which will bridge the San Gabriel River Freeway now under construction on both sides of the interchange. The San Gabriel River is top left.

Its purpose is to determine the present and future needs for moving people and goods in the greater Los Angeles area. This is being done by relating these movements to the distribution of land uses, population, employment, and other factors affecting travel. The study has been established as a continuous planning operation utilizing new data and methods in an orderly program of updating.

The 9,000-square-mile LARTS study area includes most of the land lying between Santa Barbara and San Diego and inland for an average distance of 75 miles. Nearly 8,000,000 persons move about in 4,000,000 motor vehicles now. By 1980 the population will be almost twice as great while motor vehicles will have more than doubled.

The goal of LARTS is to express this tremendous growth in terms of transportation needs which state and local officials can use in planning vital community services such as sewers, water and freeways on a priority basis. Among other things, it will serve as a basis for review of the California freeway and expressway system which was adopted by the State Legislature as Senate Bill 480.

Work is underway in the division to develop the best methods for using LARTS results and methodology in highway and freeway planning problems. Data from the completed 1960 land use inventory and other basic LARTS material have already been utilized by a few other government agencies. Many local road and planning departments have changed previous planning procedures in preparation for making the best possible use of LARTS information.

The first report of major results of the Los Angeles Regional Transportation Study is ready to be published. It will be in two volumes—one for 1960, the other for 1980. Publication of these volumes follows a year of intensive processing and analysis involving millions of pieces of data and hundreds of hours of computer time in division headquarters office. It also reflects the continuing high level of working cooperation between the division and all of the other agencies participating in LARTS.

Freeway Call Boxes

On November 1, 1962, the world's first solar-powered emergency call system was installed on 10 miles of the Hollywood, Harbor, Santa Ana and San Bernardino Freeways in the City of Los Angeles. The boxes, painted traffic yellow and with a reflective surface so as to be visible at night, are mounted on light standards at spacings of approximately one-fourth mile.

The self-contained and self-generating call boxes are linked by radio to the Los Angeles Police Department dispatching office so that no communications lines need be run from the boxes to the central station.

Many interesting results have been obtained with the system. From a technical standpoint it has performed very well, particularly in view of the fact that it is the first system of this nature to be installed anywhere in the world. The central station equipment has been in continuous operation 24 hours a day since last November to run up over 2,000 hours of operating time since then, with only two hours of shutdown due to system inoperativeness during the entire period.

There has been, on the average, one call for assistance by a motorist through the system every two hours, day and night, since the system began its operation. During the first month of operation, the system was used by the motorist to carry 70 percent of his requests to the police department for assistance.

Future Prospects

Freeway construction continues to keep pace with California's expanding economy and swelling population, which at the beginning of January 1963 was 7,662,358 in Ventura, Orange and Los Angeles Counties. With annual apportionments for right-of-way and construction standing at about the $163,000,000 mark, expectations are that the freeway-expressway system will be substantially developed by the target year of 1980.

In 1963 almost 53 miles of new freeway will be thrown open to public use, which will mean a record year for freeway construction in the tri-county district. The construction cost will be $93,585,000.

The planning program for fiscal years 1964-71 shows that $356,297,000 in construction funds and $164,969,000 in right-of-way moneys will be required to finance new construction (114 miles) and widen existing routes (31 miles) on the interstate freeways. The remaining 805 miles of the California freeway-expressway system will add $1,758,000,000 in construction and $1,300,000,000 in right-of-way expenditures.

The grand total investment in all routes comprising the District VII freeway and expressway network will exceed $5,000,000,000. In terms of actual freeway in use in the next two decades, Los Angeles County will have 1,064 miles, Orange County 248 miles, and Ventura County 263 miles.

BLIND CENTER BIDS RECEIVED

The Division of Architecture received bids from 27 contractors in March for the construction of an orientation center for the blind in Albany. Intended to train blind persons in techniques needed for functioning in competition with seeing people, the center will have a 40-unit, 2-story dormitory, a 1-story administration and classroom building, and a combination recreation and dining-kitchen unit.

E. Withycombe Made A.S.C.E. Life Member

Life membership in the American Society of Civil Engineers has been awarded to Earl Withycombe, Sierra County Supervisor and retired Assistant State Highway Engineer of the California Division of Highways. Withycombe retired from his job with the State in 1957, but has remained an active member of the local section of A.S.C.E. He was elected a Sierra County Supervisor in 1962.

Withycombe was appointed a special assistant to the State Construction Engineer in 1924, and traveled over the entire State inspecting road contract work. The standards he required to be maintained are considered by many to have been an important factor in making the paving on California highways outstanding in the United States.

He was born in Portland, Oregon, in 1892, and received his degree in engineering from the University of Oregon. His father, James Withycombe, was Governor of Oregon from 1915 to 1919. In 1921 Withycombe joined the California Division of Highways as a resident engineer, and rose to head the Construction Department for the entire State in 1947. In 1950 he was promoted to Assistant State Highway Engineer, Operations, the position from which he retired.

COST INDEX INCREASES

The California Highway Construction Cost Index for the first quarter of 1963 stands at 250.4, an increase of 17.8 points or 7.6 percent over the fourth quarter of 1962.

Projects started during this quarter are well distributed over the entire State representing a cross section of typical highway jobs.

The number of bidders per project during the first quarter averages 6.3, an increase of 0.2 over the previous quarter.

GOVERNOR APPOINTS ERRECA PUBLIC WORKS HEAD



John Erreca, of Los Banos, is sworn in as Director of Public Works by State Highway Transportation Administrator Robert B. Bradford.

Governor Edmund G. Brown has appointed John Erreca, 51, of Los Banos Director of Public Works to succeed Robert B. Bradford, who will assume his duties as Administrator of the Highway Transportation Agency full-time. Erreca's appointment was effective April 15.

"The increasingly complex and urgent questions of transportation which face our growing State demand the full-time effort of an experienced and energetic administrator," the Governor said. "No one fills that bill better than Bob Bradford, who has distinguished himself as one of the finest Directors of Public Works in California's history."

"I am delighted that John Erreca has consented to serve as his successor," the Governor said. "His experience in public service, on the Highway Commission, and in the League of California Cities will be of great benefit to him and to the department."

Erreca, a farmer and cattleman, is a native of Los Banos. He attended public schools there and was graduated from St. Mary's College.

He was a member of the Los Banos City Council from 1938 until 1961 when Governor Brown appointed him to the Highway Commission. He was Mayor of Los Banos from 1944 to 1961.

In 1953, Erreca was elected to the board of directors of the League of California Cities and served as its president in 1959. In 1960 he was chairman of the league's highway committee.

He is a past president of the Merced County Livestock Association and president of the board of directors of the Merced County Spring Fair.

His post, in which he serves at the pleasure of the Governor, pays $22,050 a year.

Erreca and his wife, Ida, have two daughters and a son.

IN MEMORIAM

District III

Johnie R. Dowden, highway maintenance man III.

District IV

Maurice F. Lynch, assistant highway engineer.

Vernon A. Kagg, highway maintenance man II.

District VI

Manuel C. Villalovos, highway landscaping leadingman.

District VII

Peter E. Kay, senior delineator.

Howard F. Long, bookkeeping machine operator II.

George F. Stransky, highway maintenance man III.

District VIII

Robert L. Swarens, assistant highway engineer.

District X

Ferrell S. Clark, highway maintenance man II.

Spencer J. Sparks, senior right of way agent.

Headquarters Office

Edna L. Norheim, intermediate typist-clerk.

Bridge Department

James D. Vernon, engineering aid II.

Robert D. Gardner, highway engineering technician I.

Forrest H. Starr, senior delineator.

State-owned Toll Bridges

Carver Westbrook, toll collector.

Headquarters Shop

Wallace L. Carpenter, auto mechanic.

Shop 1

George N. Bruun, highway equipment mechanic.

Urban Planning

Need for Co-ordination Stressed at Conference

California mayors, councilmen, supervisors, and city and county planners and engineers were put on notice that federal funds will not be available for highway projects in urbanized areas of more than 50,000 after July 1, 1965, unless they are based on a continuing, co-ordinated and comprehensive urban transportation plan.

This warning was presented at the first Regional Urban Transportation Planning Conference to be held in the West by the opening and next-to-closing speakers, State Highway Engineer J. C. Womack and City and County Projects Engineer C. T. Ledden of the Division of Highways.

The conference, sponsored by the American Association of State Highway Officials, the National Association of Counties and the American Municipal Association, was held at the Hotel Senator, Sacramento, February 25 and 26. Also in attendance were officials of state and federal governments and organizations involved in transportation.

"After the '65 date," Womack said, "such planning is mandatory under the terms of the Federal Aid Highway Act of 1962.

"It is not only desirable to co-operate fully in the development of urban planning—it is a *must* if we are to receive federal-aid financing for highway projects in affected communities."

He added that the forthcoming street and highway needs study required by the Streets and Highways Code must be useful to all rather than be "just another study," and said, "We expect this conference to indicate some ways to make the needs studies more useful to our urban areas."

Pointing out that $240,703,000 in federal funds will be expended in 10 of the State's larger metropolitan areas in fiscal 1963-64, Ledden said:

"Figures such as these should be impressive not from the standpoint that our city, county and State will be so much better off for having received these moneys, but because they represent moneys that our city, county or State is entitled to but may not receive if we do not comply with the comprehensive planning requirements of the Federal Aid Highway Act of 1962."

Senator Collier Speaks

State Senator Randolph Collier, chairman of the Senate Transporta-



A. S. Koch, road commissioner of Orange County and president of the County Engineers Association, addresses the Regional Urban Transportation Planning Conference in Sacramento, February 25. Others, left to right, are: Elton Andrews, planning officer, State Office of Planning; John Bergin, councilman, City of Riverside, and vice president of the League of California Cities; Robert Boles, supervisor, Calaveras County, and chairman of the Highway Committee, County Supervisors Association; Robert McCabe, regional director, U.S. Housing and Home Finance Agency, San Francisco; Robert B. Bradford, Administrator, State Highway Transportation Agency; and Sheridan Farin, regional engineer, U.S. Bureau of Public Roads, San Francisco.

tion Committee, welcomed the delegates and reported on pending legislation affecting transportation. He spoke of increasing traffic congestion and, while expressing favor for planning various means of moving people and goods, said that major stress must be placed on highway improvement.

Financial Assistance Explained

Tracy B. Augur, assistant to the Commissioner (Urban Planning), U.S. Housing and Home Finance Agency, explained the types of federal financial and advisory assistance available to metropolitan areas from the Urban Planning Assistance Program, Section 701 of the Housing Act of 1954.

Augur differentiated between the types of assistance for urban transportation planning offered by the U.S. Housing and Home Finance Agency (701 funds) and the U.S. Bureau of Public Roads.

"It is obviously desirable to have the planning of future transportation systems and the planning of future land uses and community facilities carried on as parts of a single operation aimed at producing a convenient and attractive city," Augur said. "Recognizing that fact, the two agencies of the federal government that are in the best position to help such co-ordinated planning have, in a sense, pooled their resources."

The Chief of the Urban Planning Division, U.S. Bureau of Public Roads, G. E. Marple, followed Augur to the rostrum and admitted the difficulties caused state and local planning bodies by lack of firm definitions of the terms of the new highway act. He estimated that the "ground rules" would be promulgated in approximately two months.

Federal Officials Attend

Other federal officials on the conference program were John Nolen, director of transportation planning, Housing and Home Finance Agency, Washington, D.C., and the San Francisco regional chiefs of the Bureau of Public Roads and the Housing and Home Finance Agency, Sheridan Farin and Robert McCabe, respectively.

Nolen spoke on planning public mass transportation, while Farin and McCabe outlined federal responsibilities for developing a comprehensive planning process.

Comprehensive Program Important

Robert B. Bradford, administrator, State Highway Transportation Agency, said that a comprehensive planning program was important for the whole State and promised state attention to rural areas as well as urban.

Bradford added that California was the first state to adopt a 20-year master plan for freeways and expressways and that comprehensive urban transportation planning in several of its larger metropolitan areas was well advanced.

The Planning Officer, State Office of Planning, Elton Andrews, spoke of the importance of the urban planning process being on a continuing basis and defined state responsibilities to cities and counties.

Research Economist Richard Zettel, Institute of Transportation and Traffic Engineering, University of California, hailed a new trend toward "policy makers becoming involved in the comprehensive planning process."

John Bergin, councilman, City of Riverside, and vice president of the League of California Cities, stressed the importance of legislators not making concessions in zoning regulations which would weaken adopted plans. He was followed by Supervisor Robert Boles, of Calaveras County, chairman of the highway committee of the County Supervisors Association, who termed the problems of urban transportation planning as so complex as to warrant an interdisciplinary approach. He urged the hiring of "top level" personnel.

Los Angeles Study Described

A massive, interdisciplinary attack on urban transportation planning, the Los Angeles Regional Transportation Study (LARTS), was described by John McDonald, director of engineering and technical services, Automobile Club of Southern California. The LARTS area embraces the five Counties of Los Angeles, Ventura, Orange, San Bernardino and Riverside, over 118 cities in these counties, and several public and private transportation organizations.

Since the City of San Diego has been engaged in comprehensive transportation planning since 1954, and as early as 1956 was selected by the National Committee on Urban Transportation as one of seven "pilot" cities in the nation, the report of the city's transportation planning engineer, Keith Gilbert, proved of great interest.

Gilbert, as did several other speakers, emphasized the need to build public understanding through many communications media.

Outstanding Example

Speaking of the pilot city program, Richard C. Cowdery of the American Municipal Association, Washington, D.C., cited the one in Madison, Wisconsin, as an outstanding example of how it can be used to train planners from surrounding cities. Karl Noerr, the traffic planner of Madison, made a slide presentation of his city's progress at a luncheon session.

Curtis Nagel, councilman, and M. J. Carozza, director of public works, City of Fresno, described the Fresno-Clovis Metropolitan Area Project, and Fritz Zapf, city engineer of Pasadena, pointed out the contribution of the Los Angeles Metropolitan Transportation Engineering Board in establishing the LARTS project.

Data Use Enlarged

David Speer and William Jones, road commissioners of San Diego and Solano Counties, respectively, recommended that in the 1964 needs study, by adding information to the data processing cards, the information developed could also serve the comprehensive planning requirements of the Federal Aid Highway Act of 1962.

A. S. Koch, road commissioner of Orange County, and D. J. Steele, division engineer, Bureau of Public Roads, Sacramento, presided over the afternoon sessions.

The California Division of Highways served as conference co-ordinator, with C. G. Beer, urban planner, assisted by Charles Zell, senior highway engineer, in charge of arrangements.

Pacheco Pass

Highway Relocation Includes 11,400,000-cubic-yard Fill

By LOUIS G. KROECK, District Design Engineer



Constructing a fill as high as a 25-story building, moving 11,400,000 cubic yards of earth and rock, and designing an embankment to be inundated for 115 feet of its height—these are just a few of the unusual problems encountered by the engineers of the Division of Highways as a result of the creation of the San Luis Unit of the Central Valley Project.

That portion of the San Luis Gonzaga land grant known as the San Luis Flat has for many years been a quiet valley dotted with grazing cattle. This valley lies east of the Diablo Range about 12 miles west of the Town of Los Banos. At present, the valley is divided by State Sign Route 152 (the Pacheco Pass Highway).

Over the next few years, this valley will be buzzing with activity as construction of both the San Luis Dam and the new Pacheco Pass Highway progresses. The San Luis Reservoir, formed by construction of the new dam, will provide the only lake of any significant size on the west side of the San Joaquin Valley. When the reservoir is filled, it will cover more than 13,000 acres and will have a capacity of over 2,000,000 acre-feet of water. Boating, fishing, picnicking, and aquatic sports will be the objectives of a vigorous recreational program. With this recreational program, the expected traffic volume on the Pacheco Pass Highway will be greatly increased. The awarding of the highway and dam contracts marked the epoch of activity for this once pastoral valley.

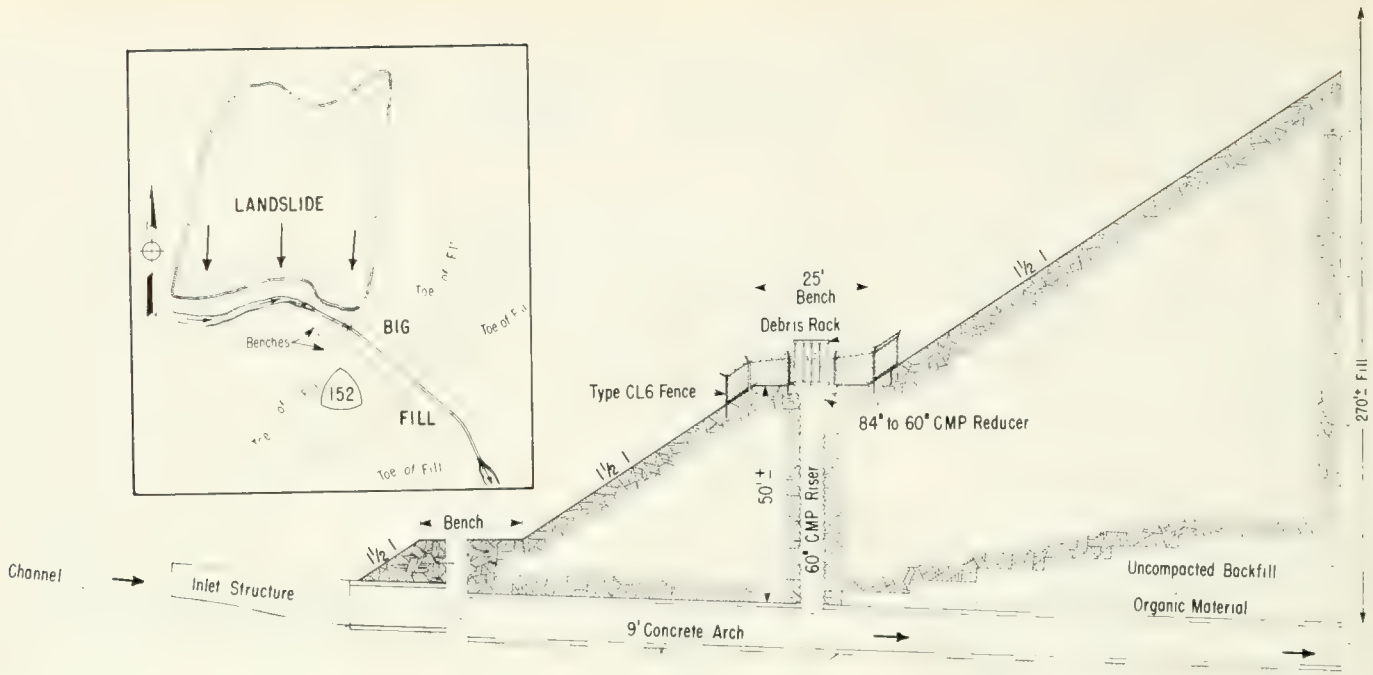
Federal-state Co-operation

The San Luis unit is a major addition to the sprawling Central Valley Project and will also become an essential link in the giant State of California Water Plan. The federal government and the State of California join hands to become partners in this vast water development program. With the construction of the San Luis Dam and Reservoir comes the necessity of relocating a major portion of the Pacheco Pass Highway. Work on the 12-mile relocation is rapidly getting under way. As the federal government and the State have co-operated in the financing of the San Luis Dam, so is the highway relocation being jointly financed by the Federal Bureau of Reclamation, the State Department of Water Resources, and the State Division of Highways. Design and construction of the $12,000,000 project is under the direction of the State Division of Highways, District X in Stockton.

Since the beginning of design work on this highway project, time has been a very critical factor. In order not to delay the progress on the major phase of the water project, the relocated Pacheco Pass Highway must be able to carry at least two lanes of traffic by



The locations of the present and future relocated sections of Sign Route 152 are shown in the above map. The shaded area indicates the land that will be covered by the San Luis reservoir. The inset map shows the general location of the project.



THE BIG FILL. The above sketch shows the arch culvert entrance and its secondary inlet.

January 1965. With a bid opening in January 1963, less than two years are available to move approximately 11,400,000 cubic yards of earth and rock, pave the 12 miles, and construct two 560-foot-long bridges.

Problems in Design

In general, the existing highway follows a ridge down into the floor of the valley. This is a natural location that required very little earthwork. Although the standard of alignment of the existing highway is far below our present criteria, the terrain is such that relatively high standards could now easily be obtained with modern earthmoving equipment.

The new location skirts the north edge of the proposed San Luis Reservoir, crossing deep draws and high ridges. In general, the terrain is steep and rough and normal to the alignment. None of the many locations studied were easily adaptable to highway location. In few places has it been possible to take advantage of a sidehill location. After design was well advanced, a detailed ground survey by the geologic section disclosed an old but potentially dangerous slide area almost centered on our proposed alignment. This dismal picture was complicated by two faults that appeared to intersect just below the slide mass, plus the action of an intermittent stream that will continue to erode the toe of the slide and increase its instability. Recent slumping of the slide mass was evident at several locations. It appeared that the extent and volume of this slide was more than could be overcome, in view of its proximity to our highway; consequently, one of our few sidehill locations was abandoned in favor of "jumping" a canyon 280 feet above the stream. Thoughts immediately turned to a bridge. This site would require a bridge 1,200 feet long and the terrain dictated that it be on a 1,500-foot-radius curve. Economic comparison was made and it was concluded that a 280-foot-high fill would not only be more economical, but also would save time in design and construction.

Size of Fill

If conditions for a successful fill of this magnitude had not been nearly ideal, the only alternative would have been the construction of the more expensive structure. To give some idea of the size of the fill required, the width across its base equals more than three average city blocks. The height will approximately equal the San Gabriel No. 2 Dam or the Don Pedro Dam. It will be higher than the Morena Dam, the Lake Spaulding Dam, or the Folsom Dam. It will be only 70 feet shorter than the largest Pyramid of Egypt. The huge San Luis Dam itself will be only 40 feet higher.

The terrain is a steep canyon over which the highway crosses at approximately right angles. The hills on each side of the canyon are competent rock with only a light overburden. Large cuts within easy haul consist of broken sandstone, which will provide enough material for the lower half of the "big fill." The remainder of the fill will consist primarily of metasandstone, phyllitic shale, with some softer material from the north cuts that have been interbedded with the harder rock. This fill is unique and will bear close watching, both during construction and for several years thereafter.

Another distressing fill problem developed at Cottonwood Creek, when it was again determined that a fill would be more economical than a bridge. This fill is over 2,000 feet in length and has a maximum height of approximately 125 feet. The size of this fill was, in itself, a problem. The problem, however, mounted when it

was determined that this fill would be subjected to inundation by the fluctuating water levels planned for the San Luis Reservoir. At planned high water level, the embankment will be completely inundated except for the designed freeboard of 10 feet. At low water level, the embankment will be completely above the water in the reservoir. This embankment will, therefore, be subjected to the most critical case for slope stability; that is, a fully saturated embankment exposed to a rapid drawdown of the water level in the reservoir.

Drawdown Rate

The rate of drawdown of this reservoir could be as much as two feet per day. At this rate, the water surface will be lowering much more rapidly than the water can drain out of the embankment.

To increase the problem, soil tests showed that the cuts on each side of this fill will produce clay materials with expansive characteristics. This material could be used only for the core of the fill. The outer zones of the fill must be constructed of a free draining material selected from other cuts. This outer core, in conjunction with a 10-foot facing of rock slope protection, must provide enough weight to prevent sloughing of the clay core.

Thirteen other fills on this project will also be subjected to inundation of various depths. All the fill slopes that are to be inundated were designed with a 2:1 slope.

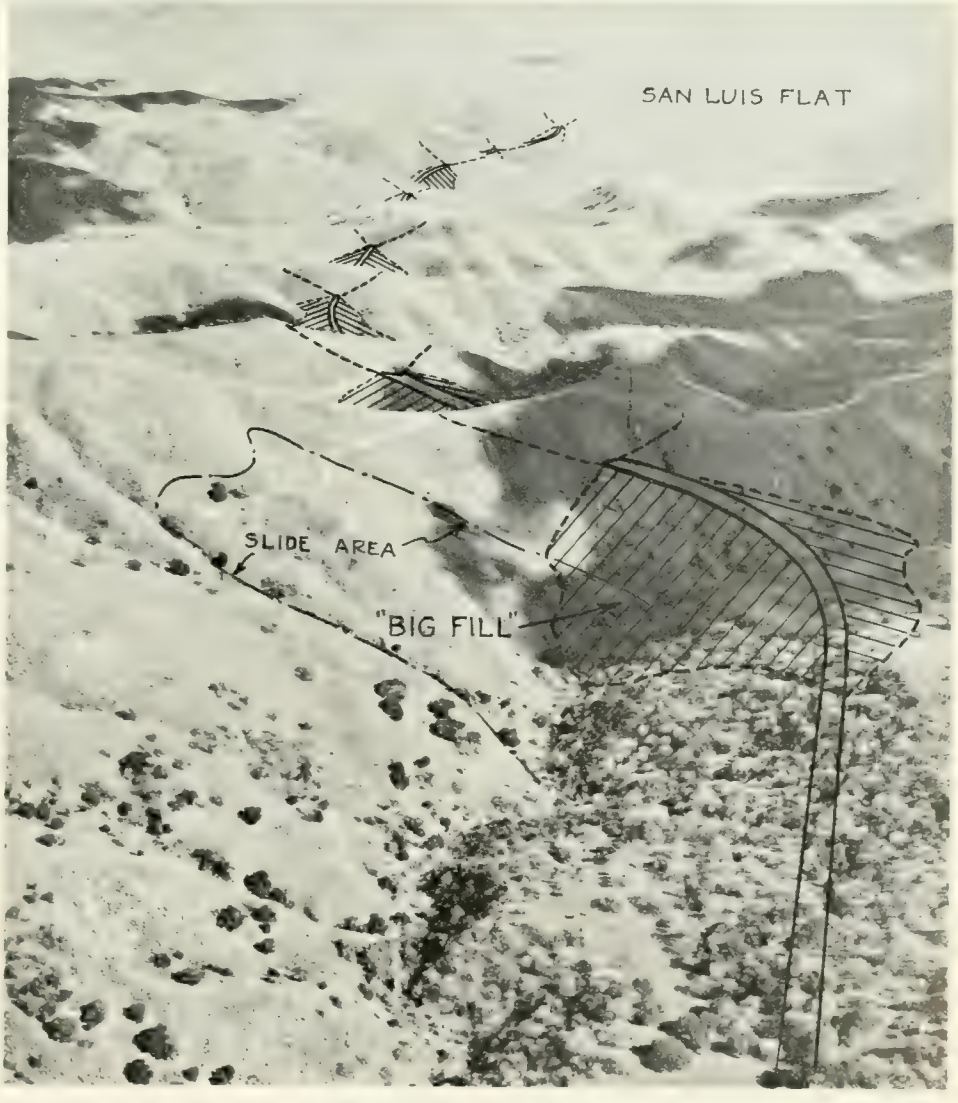
In the vicinity of Station 133, the proposed line crosses the approximate center of a long narrow landslide. The mass of this slide is at a low angle, indicating a fluid condition. Due to the terrain, the location could not be economically altered. The borings were wet and indicated the depth of the slide mass to be approximately 50 feet. The volume of the material involved in this slide made removal unfeasible.

To cope with this problem, stability trenches are to be constructed up to 50 feet in depth, and a system of filter pipes is to be installed which should effectively drain and stabilize the mass prior to construction of the proposed fill. After the installation of the filter system, little difficulty in this area is expected. In normal highway designs, this problem would have been considerable, but on this anomalous project, was so minor as to become almost lost in the magnitude of the unusual.

Special Attention for Culvert

Another problem requiring special attention is the culvert at the bottom of the 280-foot-high fill. This culvert must be capable of carrying 1,700 cubic feet of water per second during the design storm. After much study and consultation with the Bridge Department, a nine-foot concrete arch was determined to be the most feasible. A culvert this small could be used only if we could increase the velocity of flow. A "dropdown," or accelerator, was designed at the entrance which will increase the design velocity to almost 30 feet per second. This acceleration is simply a warped inlet structure 40 feet long that drops the water eight feet on a smooth transition.

For 130 feet ahead of the inlet structure, a channel flare is shaped out of solid rock on an approximate 10-percent grade to give the flow a primary acceleration. The water will further accelerate within the culvert. All this, of course, requires special design of a discharge structure to decelerate the water before its release into its original channel. This energy dissipator consists of a flared channel constructed of an eight-foot layer of two-ton rocks grouted in place to provide as rough a channel as possible. This flare



The superimposed drawing on the above photo shows the future location of the big fill.



The proposed realignment drawn over this photo of the existing terrain shows location of the cut and fill portions. The present highway can be seen in the upper part of the photo.

is 65 feet long and ties into the solid rock bed of the natural waterway.

The total length of this nine-foot arch is 1,042 feet with the middle 625 feet of heavy design to withstand the static load imposed by the high fill. A six-foot depth of compressible organic material, plus a 12-foot-thick layer of uncompacted backfill material will be placed on top of the arch to allow for settlement of the large fill. Instrumentation will be placed in this arch in order to learn more about the forces involved under a fill of this magnitude. There is much to learn regarding stresses in structures under high fills, and, for this reason, the designs are probably overly conservative. It is hoped that the instrumentation in this installation will add to our knowledge and result in more economical designs in the future.

Landslide Danger

Another unusual problem encountered at this culvert location was the possibility of the entrance being partially or totally blocked by the same landslide that forced us into constructing the 280-foot fill. The canyon upstream from the fill rises rapidly, providing little water storage capacity. Unfortunately, a storm severe enough to fill the canyon could very possibly reactivate the landslide and dump as much as half a million cubic yards of rock and clay over the entrance to the nine-foot arch culvert. This, of course, could be disastrous, since there is no alternate route for traffic for many miles, and the failure of this fill could take many months to repair.

After considering several possible solutions, we chose to provide a secondary inlet to the nine-foot arch 50 feet above the top of the culvert and at a location clear of the effects of the slide. This secondary inlet consists of a vertical corrugated metal pipe 60 inches in diameter with its inlet located on a bench. The entrance is protected by a heavy debris barrier plus a high chain-link fence to prevent curious hunters from the 50-foot vertical drop. Fifty feet of water should have little detrimental effect on this 280 foot fill.

Entrance Capacity Increased

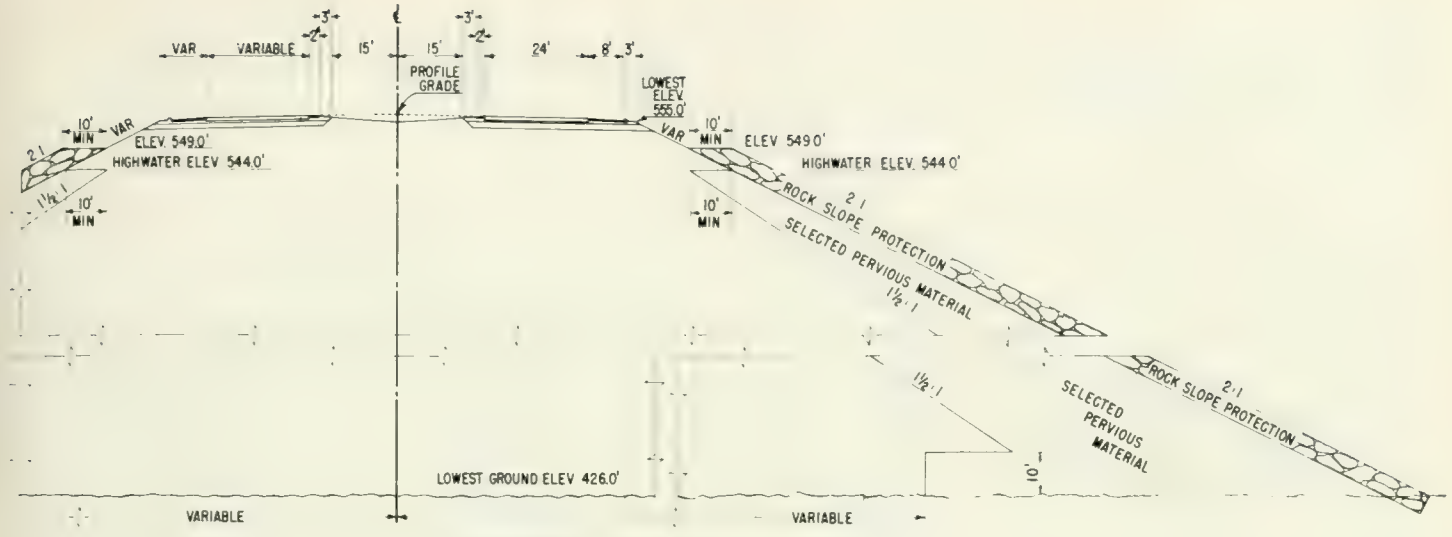
The capacity of this secondary entrance is increased by the use of a standard 84-inch to 60-inch reducer which will allow the flow of water to accelerate before it is restricted to the 60-inch-diameter pipe. Corrugated metal pipe was chosen at this location because of its inherent ability to yield as the fill settles. To prevent any appreciable force from being imposed on the concrete arch by the vertical pipe, a slip-joint is provided at the junction of the metal pipe with the arch. We hope that the secondary inlet will never be needed, but until the time it falls into desuetude, it will stand as a safeguard beside the gigantic fill.

At eight locations on this project, the fills crossing the ravines are of such magnitude that it was necessary to provide service roads down to the entrances of the culverts, furnishing access for our maintenance forces. It is too much to expect even the most energetic and dedicated members of our maintenance forces to descend and climb back up the face of these high fills. The service roads consist only of a 16-foot-wide graded roadbed on a maximum gradient of approximately 22 percent. Although the standards of these roads are low, we are sure that many times in the future the maintenance force will appreciate the forethought of the designers. Since it is anticipated that these roads will be used by the contractor for haul during the life of the contract, we feel that the added cost is nominal.

Consideration was also given to ease of maintenance during the design of the many benches in the cut sections. In all the major cuts, at least the first bench has access from the highway.

Truck-climbing Lanes

This new portion of the Pacheco Pass Highway rises only 1,100 feet in the 12 miles; however, due to the topography, there are several locations where grades up to 6 percent are necessary. Since this route is a main link between the San Francisco area market and the lush farming areas of the southern San Joaquin Valley, it is used



COTTONWOOD CREEK FILL

heavily by trucks. Because of this heavy truck usage, an additional lane for the climbing trucks has been provided on all grades of 5 percent or over. The maximum superelevation provided on this lane will be 5 percent since the trucks will be moving very slowly. The total length of climbing lanes to be provided will be 4.3 miles.

Testing

After the district materials department had made several borings along the line, it was obvious that a more extensive study would be required. The foundation section of the materials and research department was called upon for assistance. The primary purpose of the additional investigation was to obtain information pertinent to cut slope design and foundation stability. This investigation consisted mainly of taking cores with a 2⅞-inch double-tube rotary core barrel with either a diamond bit or a tungsten carbide bit. A heavy drilling mud was the circulating medium in all rotary holes.

A total of 1,520 feet of coring was removed from the ground, and a total of a mile of holes was drilled in our efforts to obtain a knowledge of the natural subsurface structure and the hydrologic problems that might be encountered. In addition to the cores, use was made of a 12-channel refraction seismograph, using explosives for the wave source.

The rocks in this area are of Franciscan formation and are predominantly deeply weathered metasandstone and interbedded phyllitic shale. Chert is also in evidence along the line. The Franciscan rocks have been strongly folded into a complex structure, and there is indication of a complex system of faulting. Landslides and earth slumping have occurred in many places in the area. In general, the type of material and the rapidity with which it changes does not lend itself to ease of slope determination, especially where cuts of over 100 feet in depth are common. Thanks to the ability of our foundation section, we were guided out of trouble at several locations.

Co-operation

The design of this project was accomplished in record time. Only the complete co-operation of everyone involved made this possible. The Department of Water Resources and the Bureau of Reclamation were very helpful. Special mention must be made of the excellent service rendered by the materials and research department and the bridge department. They were ever ready at a moment's notice to lend a helping hand in a consultant capacity.

Use of Area

Since the entire reservoir is owned by the State, the contractor is not restricted to operate within the right-of-way limits. In this rough terrain, this fact will be a definite aid to the contractor's operation, and for this reason, the contract does not call for the construction of the freeway fence until the last order of work.

Some idea of the size of this project can be obtained by the following quantities:

Roadway excavation	11,400,000	cubic yards
Selected pervious materials	523,000	cubic yards
Overhaul	223,000,000	station yards
Portland cement	117,000	barrels
Permeable material	73,000	tons
Perforated pipe	26,500	feet
Rock slope protection	180,000	cubic yards
Fence	139,000	feet

The contractor for this project is McNamara and Mannix. The project should be completed in the spring of 1965 at a cost of over $12,000,000.

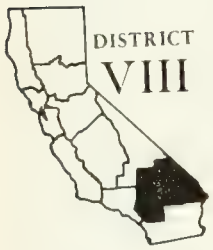
As the average motorist rides over this new highway enjoying his view of the placid waters of the reservoir, little will he know of the difficulties encountered by the engineers in the design and construction of this project. Little will he care that he is traveling over the highest embankment ever constructed by the Division of Highways.

Editor's Note: After completion of this project, a "followup" article will appear on the actual construction of this unusual project.

Mojave River Bridge

New Structure Spans Victorville Narrows

By R. W. AUSTIN, Project Engineer



On December 21, 1962, the improvement of State Sign Route 18 through Victorville, including a new 447-foot bridge across the Mojave River and the A.T.&S.F. railway at the Victorville Narrows, was completed, thereby eliminating a narrow hazardous crossing. This four-lane highway project between one mile east of Victorville and the Barstow Freeway, in addition to the bridge construction, consisted of the widening to a 64-foot all-paved section through the business district of Victorville and a four-lane divided facility easterly of the Mojave River.



The Mojave River Bridge and Overhead at Victorville Narrows, looking eastward. The recently completed bridge carrying Sign Route 18 traffic is on the right. The old arch bridge on the left now serves as a haul road for ore trucks to a lime rock products plant.

Safety Is Improved

This construction improves the safety and capacity of Sign Route 18 for traffic from the Apple Valley area to the Victorville, Oro Grande, George Air Force Base and Adelanto areas.

The westerly approach to the old steel box girder arch bridge and plate girder overhead was on a short radius curve and had inadequate superelevation. These substandard geometric features combined with the 20-foot curb-to-curb width on the bridge resulted in a high frequency of accidents at this location.

Truck Traffic

The Victorville Lime Rock Products Plant, located westerly of and adjacent to the old bridge, generated a considerable amount of truck traffic. This traffic, predominantly semi-truck and trailer combinations of which many negotiated a left turn into the plant area, further contributed to the traffic problem.

Old Bridge Retained

The original intent had been to demolish the old bridge; however, in the latter stages of design of the project, it was realized that by retaining the picturesque old bridge and a portion of a superseded county road, the trucks hauling ore to the plant would have a separate corridor to the plant and would not enter the state highway.

New Connection

Trucks hauling the finished limestone products are routed to the plant via a new connection for the county road (Stoddard Wells Road) which has channelized median storage and turning lanes. In this manner, the formerly hazardous left-turn condition has been virtually eliminated.

Negotiations Are Required

The decision to retain the old bridge and provide a separate corridor to the truck traffic required negotiations and agreements with the A.T.&S.F. railway; the County of San Bernardino which agreed to accept maintenance of the old bridge and approach, the Victorville Lime Rock Products Company, and the State of California. The net result has been a source of satisfaction to all parties concerned.

Project Cost

The new $550,000 bridge was built by Osburn Constructors, a subcontractor to the Gibbons and Reed Company who constructed the overall project between the community of Desert Knolls and the Barstow Freeway. The overall project, 2.7 miles in length, was constructed at a cost of $1,210,000 under the supervision of W. S. P. Griffith, resident engineer.

Sign Route 1

Morro Bay, Cambria Sections Are Realigned and Widened

By JAMES M. STURGEON, District Construction Engineer



One of the most scenic and highly publicized highways in California is that section of State Sign Route 1 between Morro Bay and Monterey, often referred to locally as "Wonderful One."

At Morro Bay, the famous Morro Rock stands as sentinel over the southerly beginning of this scenic route. The highway continues through Cayucos on peaceful Estero Bay and then winds its way through the foothills of the Santa Lucia Mountains to Cambria and Cambria Pines. These communities attract many tourists each year, especially summer vacationers from the Central Valley.

Then the route follows the coastline northward, passing the enchanted castle of William Randolph Hearst at San Simeon, now a state historical monument visited by several hundred thousand persons each year.

Road Follows Steep Slopes

North of San Simeon the highway travels along through sparsely populated areas as it climbs the seaward cliffs of the Santa Lucia Mountains. The roadbed clings to the steep slopes and crosses the deep canyons of this wild and spectacular area, passing several campgrounds including the popular Big Sur State Park and resort area. It continues to Carmel, site of Mission San Carlos Borromeo de Monterey, and the historic City of Monterey, original capital city of California.

In a book titled "California Highways" written in 1920 by Ben Blow, manager of the Good Roads Bureau of the California State Automobile Association, the comment is made (concerning the then-proposed Carmel-San Simeon Highway).

"The country through which the road would run is so rugged in character as to try out the climbing qualities of a rocky mountain goat, but of glorious scenic attraction. . . . It is to be a shoreline road hung high above the breakers and is intended purely for a touring road . . ."

First Money in 1919

This "touring road" was originally conceived by a physician in Monterey, the late Dr. John L. D. Roberts. In 1917 he walked the coastal area from San Simeon to Big Sur just to prove to his own satisfaction that such a road could be built. Subse-

PHOTO BELOW. A scenic view of Sign Route 1 in Monterey County with Big Creek Bridge visible in the distance.





A map showing the location (dotted lines) of the recent highway construction on Sign Route 1 near Morro Bay and Cambria.

quently, Dr. Roberts joined forces with the late Senator Rigdon of Cambria to sponsor the "Coast Highway" in the newspapers, the State Capitol, and half the county seats in California. As a result, in 1919 the State Bond Act for Highways contained a provision for a new road between Carmel and San Simeon.

The original allocation for construction of this road was $1,500,000. Construction was continued over a period of years using both convict labor and private contractors. Fnally in 1937, after expenditure of more than $15,000,000, the "Coast Road" was completed and opened to traffic.

Construction Continuous

However, construction and reconstruction of this scenic coastal section has never really stopped and the end of work to preserve this scenic route is not yet in sight.

In addition to resurfacing the roadbed, repainting bridges, replacing guardrail and other types of routine maintenance, the Division of Highways has in the last five years let eight separate contracts for replacement of a considerable number of the original redwood crib-type retaining walls. New concrete crib-type retaining walls afford longer-lasting protection to the existing roadway by preventing the roadbed from slipping.

Two of these contracts cost more than $300,000 each and the total five-year expenditure for this purpose alone has amounted to over $1,400,000. More of such protection work is planned during the next few years.

In this same five-year period, substandard and overage timber bridges at Dolan Creek, Anderson Canyon, Willow Creek, and Villa Creek were replaced by atractive, permanent reinforced concrete bridges, with better designed approaches. A $370,000 contract is now underway for replacement of the existing timber bridge at Hot Springs Canyon; similar replacement of another timber bridge at Vicente Creek is scheduled to begin later this spring. As funds permit in the future, five more such bridges will also be replaced in order of priority of need.

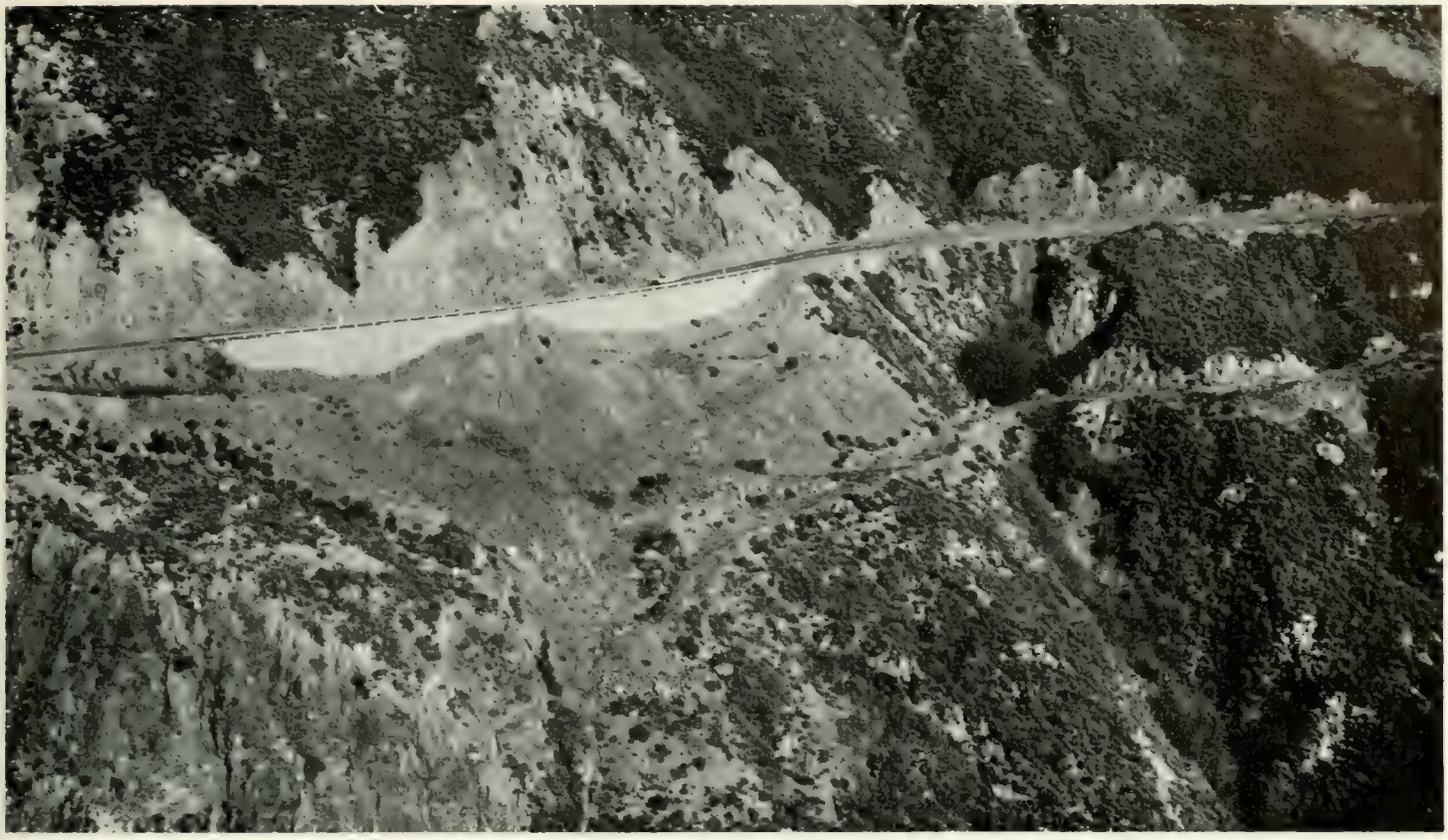
These efforts are part of a continuing planned program to preserve the highway in this most rugged terrain while maintaining its scenic qualities and improving traffic safety.

Many Scenic Bridges

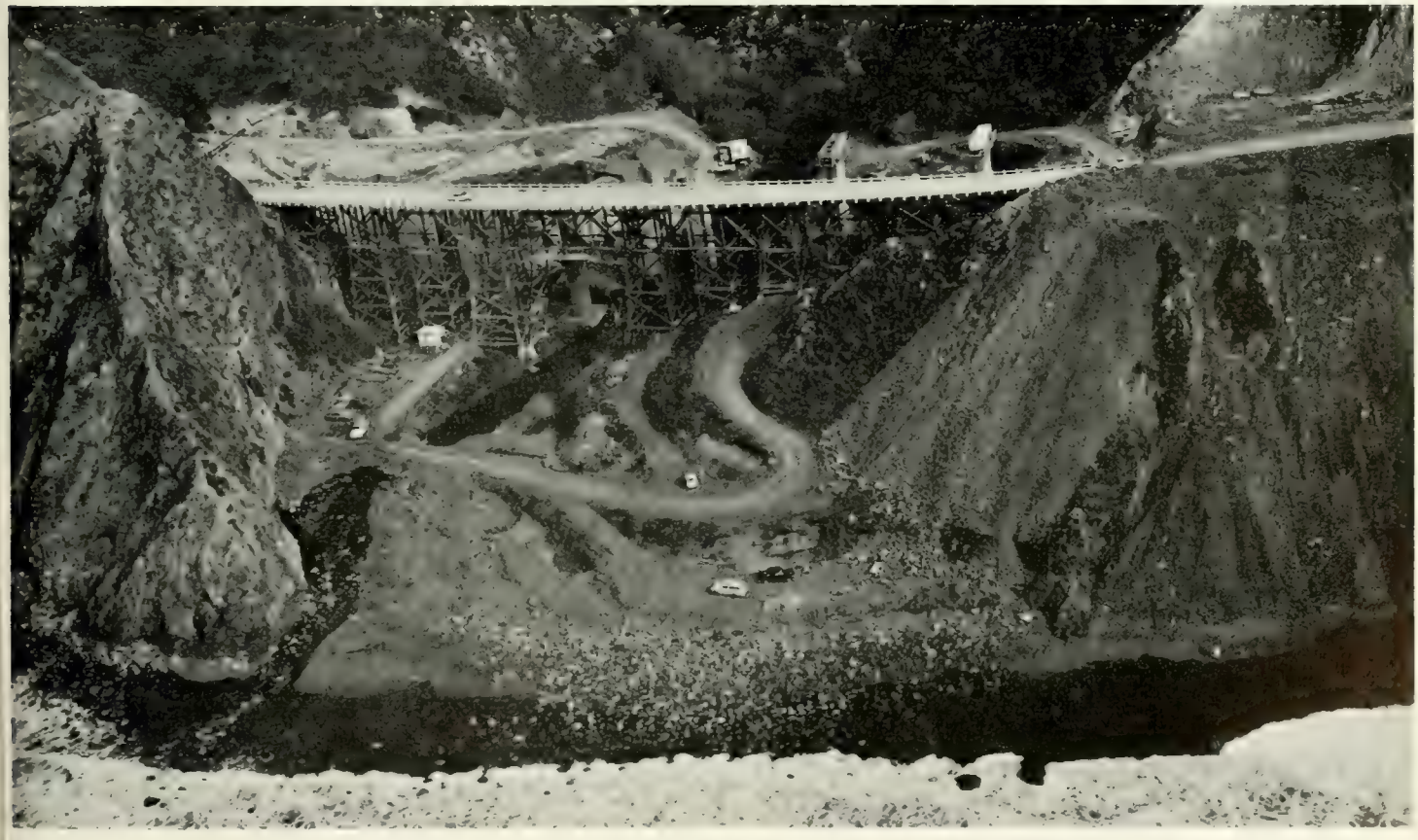
There are many beautiful bridges spanning the gorges along this section of Highway 1, the most spectacular being the Bixby Creek Bridge. This concrete arch structure can be seen from both north and south as the traveler approaches Bixby Creek Canyon and it presents a breathtaking vista. The roadway is 260 feet above the tiny stream that empties into the ocean on a beautiful stretch of sandy beach. The arch span is 330 feet in length, making this one of the highest and longest structures of its type in the country. It is one of the most photographed structures on the coast.

This section of State Sign Route 1 between Carmel and San Simeon is now under study as part of proposed statewide scenic highway system whereby every effort would be made to preserve the natural scenic beauty and minimize the encroachments of civilization.

At the southern more densely populated section of the Cabrillo Highway population growth and business expansion have been typical of a rapidly growing state.



A view of some of the extensive cribbing construction just north of Salmon Creek.



This 1961 photo shows construction of a new bridge at Willow Springs Creek directly behind the existing bridge.

To accommodate this community growth, recent extensive changes have been made on State Sign Route 1 and more work is in progress.

Twelve Miles Realigned

In November 1962, construction was completed on realignment of some 12 miles which had consisted of narrow roadbed on very poor alignment, with even worse sight distance. This route between Cayucos and Cambria was a slow, dangerous road to travel as it had 83 curves, the majority of which had a radius of 500 feet or less. Also, over the entire 12-mile route only 10 percent of the total highway length was safe for passing.

The recently completed $2,000,000 realignment of this route provides a still scenic, but safe, well-aligned highway that reduces the strain of driving and increases the pleasure of the trip along the coastline of Estero Bay and through the surrounding coastal farming lands.

Madonna Construction Company, contractor on the project, had to overcome a series of earth slides and slip-outs in addition to routine problems common to most construction projects.

In December 1962 the same contractor began a 4.5-mile two-lane controlled access project beginning at the north end of the recently completed project, then bypassing the Town of Cambria to the southwest and ending north of Cambria, joining the existing highway just south of San Simeon Creek.

As in the case of the project between Cayucos and Cambria, sufficient rights-of-way on the Cambria Bypass were acquired for future expansion to a four-lane divided expressway when anticipated increased traffic requires the additional lanes.

Construction Under Way

Construction of the initial two lanes on improved alignment is now well under way and it is hoped this $1,300,000 project can be completed and opened to traffic by September 1963.

A. J. Jorge was the State's resident engineer on the Cayucos to Cambria project, and he is also the resident engineer on the Cambria Bypass job.



A view of the recently completed two-lane highway between Cayucos and Cambria (far background). Compare the new alignment to that of the old highway to the right.

Between Morro Bay and Cayucos, 6½ miles of four-lane expressway construction is nearing completion. At the southern end of this project the route follows new alignment, bypassing Morro Bay on the north, then joining and following the existing route to the end of the new construction, approximately one mile south of Cayucos. By using this alignment the majority of the existing highway will serve as a frontage road for the benefit of local traffic.

Created Drainage Problems

This project passes through extensive and expanding residential and roadside business developments. The resident engineer, J. W. Robertson, has found that the rapid and continuous development of property adjacent to the new facility has created a series of drainage problems as streets, curbs, and storm drains replace sand dunes and sloughs.

On this project the contractor, also Madonna Construction Company, has been free of slide problems, but has been involved in a series of unusual circumstances that have hampered work.

Find Archeological Site

First, the material site selected for subbase material turned out to be an old Indian campsite of unusual archaeological interest. Production of construction materials was stopped while archaeologists carefully excavated, reconstructed the area as it had been originally used, photographed and catalogued their finds, packed them up and left the area so that highway construction could continue. This work was financed by the Pacific Gas and Electric Company, owner of the property involved.

Large Stockpile

Also a large stockpile of base material, crushed and processed at considerable expense to the contractor and complying with every applicable specification of the contract, at the time it was produced, turned out to be a "quick weathering" material that further testing indicated could not be used in the structural section of the roadbed.

Barring further complications, this long-awaited $2,050,000 project should be open to public travel by June 1963. Immediately thereafter, functional planting for erosion control and tree planting for highway beautification is planned.



The southern end of the project between Morro Bay and Cayucos. Town of Morro Bay is in center left. Morro Rock stands in the background and P.G. & E. Power Plant in center background.

Connecting Link Planned

As a connecting link between this project and the recently completed Cayucos to Cambria project, construction is planned this year of a four-lane expressway bypassing the resort community of Cayucos on its eastern fringe. This will eliminate the present heavy traffic congestion in the center of Cayucos, particularly in summer. It will provide additional safety to all traffic by eliminating restricted sight distance in many locations, and a narrow hazardous roadway constructed in the 1920's. This project will be approximately 2.8 miles in length and will cost an estimated $3,000,000 to construct.

With completion of all these freeway and expressway projects, the growing coastal communities will find relief from the present irritating and hazardous traffic congestion. In addition, California's citizens and tourists everywhere will find an easy access from San Luis Obispo to the beach resort areas, Hearst Castle, and the State Parks and camping areas along the way.

Highway 1 is still the "touring road" dreamed of in the 1920's. Visitors should realize that the "Coast Road" from Carmel to San Simeon has many curves and grades that are almost as spectacular as the scenery. Highway 1 is still meant for meandering, for stopping and taking photographs, for observation and enjoyment. It is not made for the driver intent on setting speed records or for making a standard number of miles on a long trip.



Contraction Joints

Change in Spacing Follows 'Bounce' Study

For 20 years the California Division of Highways has been building highways with contraction joints at 15-foot intervals, but recently drivers of some late model cars have complained of a rhythmic bouncing effect on certain sections. Preliminary studies showed this was a characteristic of a number of the newer models, because of smaller wheels, softer springing, and higher speeds. Determined to provide the smoothest possible ride for California motorists and truckers, the Design Department of the Division of Highways made a series of more detailed studies of the bouncing problem, and possible ways to eliminate it.

From a theoretical standpoint, it appeared reasonable that variable spacing would tend to prevent the buildup of a rhythmic bouncing motion in softly sprung cars and particularly in commercial vehicles. There was not only the regularity of the impulses to be considered, but also the lengths of wheelbase, the springing systems, and the circumference of the tires. As all of these factors vary from car to car and from year to year, it seemed that a system of irregular joint spacing would be most likely to minimize the role of pavement joints as a contributing factor to rhythmic car motion.

Intensive Study

In co-operation with the design department, the materials and research department engaged in an intensive study of the factors which produce the riding qualities of a highway. They also developed instrumentation to be installed in various models of cars to give numerical values to comfort of ride. This work is continuing and should lead to further future improvements.

The construction department also co-operated in this project and constructed random spacing on several contracts using a sequence of 13, 17, 14, 16 feet and repeat. On one contract a pattern of 13, 14, 17, 16 feet was used with the joints sawed diagonally. There was a self-imposed limitation that the joint spacing should remain close to 15 feet and that the pattern should repeat every 60 feet.

It was believed by many observers that these patterns produced an improvement in ride, but there was no noticeable reduction in harmonic vibration and bounce in the particular cars most susceptible to this unpleasant motion.

Using these experiments as a departure point, the design department continued its studies in a conjunction with the materials and research department, exploring the problem further on a theoretical basis rather than an empirical one. Eventually, electronic data processing machines indicated a randomized joint spacing of 13, 19, 18, and 12 feet could be expected to provide optimum results.

Co-operative Effort

An arrangement was made with a major automobile manufacturer to correlate this design work with the riding characteristics of present-day automobiles, as well as the automobile of tomorrow now on the drawing board. The University of California's Institute of Transportation and Traffic Engineering was also asked to help in the tests.

A portion of the Newport Freeway near Tustin in Orange County was

selected as a test roadway, and test sections were laid out as follows:

A. On the northbound traffic lanes beginning at the southerly end of the project, these joint systems were installed:

Length	*Joint interval*	*Type of pattern*
1 mile	13, 17, 14, 16 (Repeating random pattern)	Diagonal
1 mile	13, 17, 14, 16 (Repeating random pattern)	Transverse
1 mile	15-foot uniform interval	Transverse

B. On the southbound traffic lanes beginning at the northerly end of the project, the joint spacing was as follows:

Length	*Joint interval*	*Type of pattern*
1 mile	15	Transverse
1 mile	13, 19, 18, 12	Transverse
1 mile	13, 19, 18, 12	Diagonal

When the contract was completed, the riding qualities of the pavement were thoroughly tested by the Los Angeles branch of the I.T.T.E. from U.C.L.A., by the car manufacturer, and by the headquarters materials and research department with heavily instrumented equipment. Many makes and models of cars were tested and profilograms recorded.

The Newport Freeway pavement is exceptionally smooth with a profile index of 1.7, and therefore most of the cars performed very well on all of the test sections. The vehicles most susceptible to rhythmic motion obviously were affected least by the calculated pattern of 13, 19, 18, and 12 feet.

In view of the benefit to large numbers of vehicles now using the highways, the weakened plane joint spacing of 13, 19, 18, 12 feet and repeat has been adopted. Where paving operations permit, all joints will be constructed on a slight diagonal so the vehicle wheels strike the joint at different times as this also has been found to further improve both the ride and pavement performance as well. The paving details in the standard plans have been revised to incorporate this change and changes are being made, where possible, in going contracts in the continuing endeavor to provide the best possible ride for the road user.



Newport Freeway in Orange County, shown above from an overcrossing and below from the air, was chosen for tests because it was new, and also had very good profile index. Joints show clearly in above photo; scene is close to junction with Santa Ana Freeway, intersection with which shows in aerial.



Freeway Guardrail

Installation Made Where Genuine Hazard Exists

By ROGER T. JOHNSON and THOMAS N. TAMBURRI, Assistant Traffic Engineers

In recent years the public has shown considerable interest in the subject of guardrail on freeways where private improvements are located immediately adjacent to the freeway right-of-way. A possible problem exists where vehicles run over a freeway embankment, endangering the lives and property of persons on adjacent private property.

On many occasions, property owners have requested that guardrail be installed to protect them and their property. Guardrail has been installed at several of these locations where a genuine hazard exists. But, in the main, the danger to life, limb, and property in these situations is more apparent than real.

Investigations were made in the Los Angeles and San Francisco areas to determine the magnitude of any such problems.

In the San Francisco area a field survey was made of all freeway locations without guardrailing, meeting both of the following conditions:

1. Embankment 10 feet or more in height, and
2. Improved property immediately adjacent to the freeway right-of-way without an intervening ramp or frontage road.

At the time of this study, there were 3.15 miles of freeway meeting

A typical condition were guardrail is warranted (a section of the Bayshore Freeway near Courtland Street in the San Francisco area). Note the vertical dropoff of several feet from the top of the retaining wall at the right-of-way line.





A location (this one a section of U.S. 50 in Alameda County) where guardrail is not considered warranted.

he above conditions. The accident ecord for a four-year period is shown n Table I. There have been 25 off- houlder accidents in the 3.15 miles ith nine accidents causing damage the right-of-way fence. There were o fatalities. No private property was amaged and no persons on private roperty were injured. There were no oints of offshoulder accident concen- ation.

Los Angeles Survey

In the Los Angeles area a field sur- y was made of all freeway locations ithout guardrailing, meeting both of e following conditions:

1. Cuts of three feet or less and all embankments, and

2. Improved property immediately adjacent to the freeway right-of-way without an intervening ramp or frontage road.

There were 30.50 miles of freeway meeting these conditions. The off-shoulder accident records for 1959 and 1960 are shown in Table II. There were 29 offshoulder accidents in the 30.50 miles with two of these accidents causing damage to private property.

Continuous guardrail makes some routine maintenance operations difficult and more expensive because it renders certain areas inaccessible to mechanized equipment. Guardrail increases the hazard of stopping on shoulders of eight-foot width or less, whether by enforcement officers, highway personnel, or the motorists. It forces vehicle occupants to dismount from the left or traffic side. To fix a flat tire on the left, the motorist encroaches on the travelled way; and to fix a flat on the right, the vehicle encroaches on the traveled way to allow working room on the right.

Table I

SAN FRANCISCO AREA

ACCIDENTS WHERE PRIVATE IMPROVEMENTS ABUT THE FREEWAY RIGHT-OF-WAY

(Locations where embankments heights exceed 10 feet)

Route	County	Freeway	Mileage	Accidents			Period covered years
				Total	Off-shoulder	Damaging state fence	
5	Ala	MacArthur	0.31	5	4	1	4
5	SCl		0.09	5	0	0	1½
7	CC	East Shore	0.45	16	1	1	4
68	SF	Bayshore	0.91	111	13	5	4
69	Ala	Nimitz	0.15	19	0	0	4
75	CC		0.18	3	1	0	4
107	CC		0.28	0	0	0	4
228	Ala		0.78	19	6	2	
		Total	3.15	178	25	9	

Table II

LOS ANGELES AREA

OFFSHOULDER ACCIDENTS FOR 1959 AND 1960 WHERE PRIVATE IMPROVEMENTS ABUT THE FREEWAY RIGHT-OF-WAY

Route	County	Freeway	Case*	Mileage	Offshoulder accidents		
					Injuries	PDO	Total
2	Ora	San Diego	B	0.00			
			C	0.23	0	0	0
2	Ora	Santa Ana	B	1.93	3	0	3
			C	0.16	0	0	0
2	LA	Santa Ana	B	4.01	0	2	2
			C	0.76	0	1	1
2	LA	Hollywood	B	0.79	0	0	0
			C	2.27	1	0	1
2	LA	Ventura	B	1.10	0	2	2
			C	2.58	2	3	5
4	LA	Golden State	B	0.06	0	0	0
			C	0.70	0	0	0
9	LA	Foothill	B	0.06	0	0	0
			C	0.00			
26	LA	San Bernardino	B	5.41	3	2	5
			C	1.71	3	0	3
60	LA	Pacific Coast	B	0.00			
			C	0.00			
77	LA	Corona	B	0.39	0	0	0
			C	0.00			
138	LA	Ojai	B	0.09	0	0	0
			C	0.00			
158	LA	San Diego	B	0.25	0	0	0
			C	0.40	0	0	0
161	LA	Colorado	B	0.10	0	0	0
			C	0.00			
162	LA	Glendale	B	0.15	0	0	0
			C	0.00			
165	LA	Harbor	B	0.26	0	0	0
			C	1.14	2	0	2
167	LA	Long Beach	B	2.56	3	0	3
			C	0.48	0	0	0
175	LA	Riverside	B	1.72	1	0	1
			C	0.55	0	0	0
205	LA	Pasadena	B	0.32	0	0	0
			C	0.42	0	1	1
		Subtotals	B	19.20	10	6	16
			C	11.30	8	5	13
		Total		30.50	18	11	29

*B—Three-foot cut to ten-foot fill.
C—Over ten-foot fill.
No fatal accidents occurred off the shoulder on the above freeways.
Of the 29 accidents, two involved damage to private property.

Accident Conversion

Another factor to be considered is that guardrail does not eliminate offshoulder accidents. It converts these accidents (which in the case of flat side slopes may cause little or no damage) to guardrail accidents, which may be more severe.

A summary of the data gathered discloses the following:

1. There are no points of concentration of accidents involving cars running off the roadway and damaging private property.

2. There have been 0.48 offshoulder accidents per mile per year in the Los Angeles area and 2.07 offshoulder accidents per mile per year in the San Francisco area at locations where improved property is immediately adjacent to freeway lanes.

3. In four years there were 25 offshoulder accidents in the San Francisco area. Nine of these caused right-of-way fence damage.

4. In two years there were 29 offshoulder accidents in the Los Angeles area and two caused damage to private property.

5. No fatalities or personal injuries have occurred on private property.

6. There has been very little damage to private property.

In conclusion, the incidence of offshoulder accidents is so small, scattered and unpredictable that no blanket policy of installing guardrail where improved properties exist immediately adjacent to freeway lanes is warranted. However, guardrailing should be installed at locations where concentrations do develop and at locations where the combination of superelevation, curvature, embankment height, slopes, and type of improvements are such as to indicate a potentially hazardous situation.

Among the 25 offshoulder accidents:

1. No fatalities occurred.

2. No one on private property was injured.

3. No private property was damaged.

Solano Avenue

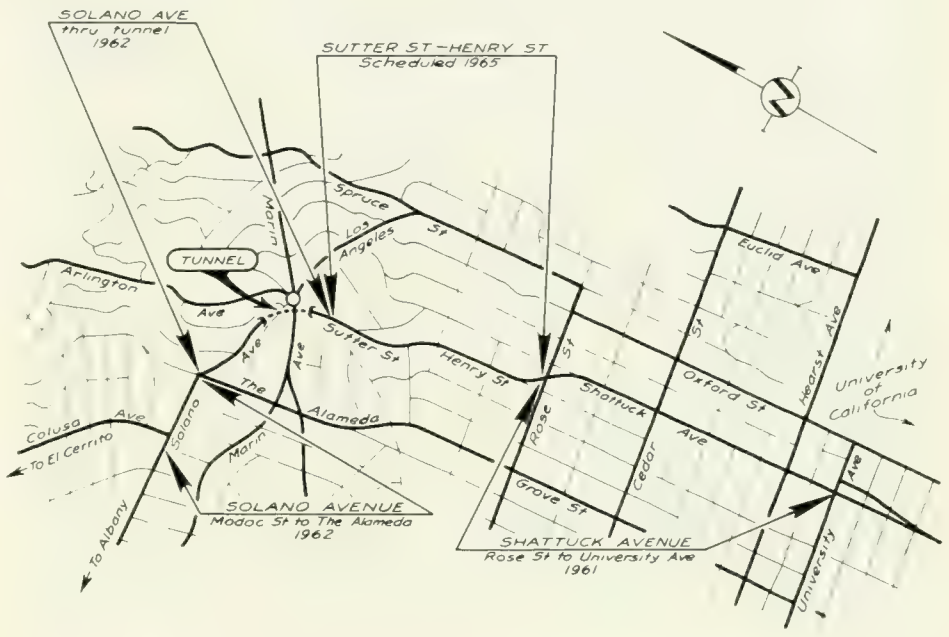
Former Railroad Tunnel Converted to City Street

By JAMES L. MARTIN, Director of Public Works, City of Berkeley



On December 15, 1962, the City of Berkeley inaugurated traffic service on a new major city street link—the extension of Solano Avenue through the historic Northbrae Tunnel.

For over 50 years, the tunnel has been an important factor in providing transportation service to the North Berkeley-Albany area. At the opening ceremonies this tradition was represented by both antique automobiles and the latest in passenger buses, and as the symbolic act of opening the street to public use, Berkeley's mayor, the Honorable Claude B. Hutchison, cut a chain connecting two lengths of railroad rail.



Location of the tunnel conversion project in Berkeley is shown in the above map.

Early Interurban Construction

In the early part of the 20th century, electric interurban railroads were being constructed in many areas to compete for passenger traffic with the steam lines. At that time, highway vehicles were not sufficiently developed to offer any threat to the lucrative rail traffic. Simultaneously, the East Bay area was undergoing a great expansion in population and real estate development. In 1903 the San Francisco, Oakland and San Jose Railway (later the Key System) obtained extensive franchises in Oakland and Berkeley for what was then a rapid transit system. Their electric trains were soon providing swift, comfortable service for commuters connecting with ferry service for the Bay crossing to San Francisco.

The Southern Pacific Railroad, which had provided steam commuter service in Oakland, Berkeley and Alameda since the 1860's, was faced with the choice of meeting the competition or completely losing the traffic to the Key System. As a result, the Southern Pacific obtained franchises for an ex-



View easterly from the west end of the project. Note the landscaping and the bus area. Tunnel is beyond the curve in the distance.

tensive interurban system, reaching from Berkeley to San Leandro. In certain cases, the new lines utilized existing railroad rights-of-way, but many of the routes followed public streets or new private rights-of-way to directly tap the main residential area.

Junction Was Planned

In North Berkeley, a junction of three lines was planned at Thousand Oaks station, near the intersection of Colusa Avenue and Solano Avenue. Difficulties were encountered, however, in location of the line connecting Thousand Oaks with downtown Berkeley. Adverse topography near Marin Avenue, and an existing Key System franchise, precluded the following of the natural contour along public streets.

Location engineers therefore designed a 464-foot double-track tunnel under the Marin Avenue Circle to connect Sutter Street on the south with a private right-of-way leading to Solano Avenue at The Alameda. The construction was by the cut-and-cover method, using nonreinforced concrete. The tunnel has walls two feet thick, with a floor one foot thick. The roof arch has a radius of 15½ feet, and the overall clearance from the floor to the crown of the arch is approximately 25 feet. The tunnel was completed in 1911 and service was inaugurated shortly thereafter.

For many years, riding the "Red Trains" to San Francisco was a North Berkeley tradition. Until 1939, the trains connected with ferries at the Oakland Mole. After completion of railroad tracks on the San Francisco-Oakland Bay Bridge, the electric trains operated directly into San Francisco, terminating at First and Mission Streets.

In 1941, the Southern Pacific gave up its electric service since traffic had declined due to increasing automobile competition. At this time, the Key System took over some of the Southern Pacific lines for operation with their streamlined interurban equipment. The tunnel was continued in use as a portion of the "F" line, with the terminus now being at Solano Avenue and The Alameda.



THEN. Interior view of tunnel shortly after completion in 1911.

Service Abandoned

In 1958, the Key System also abandoned train service and switched to bus operation for the transbay commuter traffic. The tunnel and private right-of-way were donated to the City of Berkeley. Studies indicated that a valuable street connection was possible, using the tunnel, and the project was scheduled in the Capital Improvement Program for 1962 construction.

The Solano Avenue extension project is actually one of a series of projects designed to greatly improve traffic circulation between the North Berkeley-Albany-El Cerrito area and the downtown Berkeley-University of California area.

Three are major city street projects, using ⅝-cent gas tax funds augmented with some gas tax moneys granted by Alameda County. They are: (1) the reconstruction of Shattuck Avenue from University Avenue to Rose Street, completed in 1961 under a $120,000 contract; (2) the reconstruction and widening of Sutter Street and Henry Street, from Rose Street to the southerly tunnel entrance, scheduled for 1964-65; $185,000 is included in the capital improvement program for this work; and (3) the Solano extension through the tunnel.

In early 1962, Solano Avenue was widened westerly from The Alameda and also provided with new street lighting, using $10,000 from the city general fund. Four moving lanes are provided on Shattuck, Henry, and Sutter, with two moving lanes on Solano itself. As a preliminary to the Solano Avenue projects easterly and westerly of The Alameda, a $99,500 storm drain was installed. This replaced a deficient existing drain, and was financed from a drainage bond issue.

Funds Scheduled

In accordance with Berkeley's capital programing policy, funds were also scheduled for the Solano project for street lighting and landscaping. Over the years, a luxurious growth of trees and bushes had become established along the open portions of the railroad right-of-way. We felt that the community value of this planting should be enhanced by pruning and

shaping of the existing growth, supplemented by planned installation of new trees and shrubs. The wisdom of this has been shown by favorable public reaction. It even appears that a number of drivers choose to drive Solano Avenue in preference to more direct routes simply to enjoy the beauty of the drive.

In design of the tunnel project, prime consideration was given to vehicle and pedestrain safety. A sidewalk is provided on the entire length both for neighborhood convenience and for an emergency walkway for drivers of stalled vehicles. The curvature of the tunnel and the unusual length of roadway between intersections called for carefully planned street lighting, traffic signs, pavement markings, and other safety features. There is an existing street directly above the north tunnel portal which had only an ancient iron fence separating traffic from from a sheer drop. The old fence was replaced by standard metal guardrail with an 8-foot chain link fence attached.

After soil investigation, the structural section of the roadway was determined to be 4 inches of asphalt concrete, 10 inches of untreated base, and 5 inches of salvaged railroad ballast. The roadway is 24½ feet between curbs in the tunnel. The pavement was widened on the westerly end to permit a right-turn lane on the north side, and a bus loading and parking lane on the south side. The total length of the project is 1,900 feet.

Superelevation Given

Since the tunnel is on a curve, with a centerline radius of 350 feet, the roadway was given a superelevation of 5½ percent. By careful adjustment of grades, it was possible to maintain standard height clearances throughout. The 3½-foot sidewalk was placed on the inner side of the curve for safety, and additional pedestrian protection was provided by a special barrier curb and a three-foot chain link fence along the top of curb.

The tunnel is in an area of high ground water table, and there were many points of seepage at the construction joints. The cracks were sealed and pipe drains were installed in the wall at a number of points to conduct the seep water to the roadway gutter. Prior to the paving, the tunnel and abutments were sandblasted to remove the accumulation of grime and loose mortar. The arch was then painted with two coats of standard white traffic paint. This paint proved to be inexpensive and easy to apply and gives a good reflective surface for the lighting.



NOW. Interior view of tunnel, December 1962. Note the use of reflectorized buttons, fluorescent lighting fixtures and pedestrian protection fence.

Along the open section of the roadway, lighting is provided by 23,000-lumen mercury vapor units on 30-foot metal poles. Within the tunnel, two-tube fluorescent fixtures with plastic covers are mounted longitudinally along the crown of the arch. A day-night switching arrangement gives greater light near the entrances during the day in order to form a transition. At night, the average light intensity on the pavement within the tunnel is 25 foot-candles, giving a very inviting appearance to the approaching driver.

Additional Safety

For additional driver safety, the double center line was formed with pairs of reflectorized yellow buttons, spaced three feet apart longitudinally. While the reflectorization is diminished by the lighting intensity, the buttons provide a valuable tire sound feature if a car crosses the centerline, and, in the event of a power failure, will give a very striking delineation of the roadway alignment.

The average daily traffic has been over 5,000 vehicles per day since the opening. This traffic consists primarily of automobiles and buses. Due to the lack of developed frontage along the route, the prima facie 65 miles per hour limit would apply. However, a traffic study was made as soon as traffic began using the road and the speed limit has now been established at 25 miles per hour.

By using Solano Avenue, the Alameda-Contra Costa Transit District has been able to cut three to four minutes from the schedule of both the



THEN. Southerly end of tunnel in 1911. Railroad trolley wire not yet installed.



NOW. Southerly end of Solano Avenue project at Sutter Street. The raised reflectorized buttons have proved effective in channeling traffic into the proper lane. Note extensive landscaping.

Number 33 Oakland Express and the "F" transbay bus service. The former bus route involved several sharp turns and a layover stop in a congested professional office area.

Simultaneously with the street construction, traffic signals were installed at Solano Avenue and the Alameda at the westerly end of the project. This is a fixed-time signal, with "WALK-DON'T WALK" heads, and will be interconnected later in 1963 with the remainder of the signals along the Alameda and Grove Street.

The $63,000 street contract was performed by C & H Contractors, of Richmond. The traffic signal was installed by city forces, using $4,100 in ⅝-cent gas tax funds. The tunnel painting was financed with $10,000 granted to the city by the County of Alameda; the painting contractor was R. W. Reade of Berkeley. The lighting was also installed by city forces, using general funds in the amount of $12,800.

Design and construction was under the direction of William J. Dabel, supervising civil engineer. The resident inspector was Darrell S. Nall. The city electrical superintendent is D. D. O'Leary. Berkeley City Manager John D. Phillips directed interdepartmental co-ordination. The historical photographs were made available through the courtesy of Mr. Vernon J. Sappers, of Oakland.

$9,000,000 SIERRA CENTER

The State Department of Public Works has awarded five architecture contracts totaling $9,291,324.10 for construction of the new Sierra Branch Conservation Center near Sonora in Tuolumne County.

Companion center to the huge California Conservation Center near Susanville, Lassen County, the Sierra center is the second step in Governor Edmund G. Brown's accelerated conservation camp program for the rehabilitation of prison inmates and the conservation of the state's natural resources.

Sierra's 1,216-inmate capacity plant will be located on the 240-acre McCormick Ranch about 11 miles southeast of Sonora.

Santa Rosa North

Two-lane U.S. 101 Section Is Converted to Freeway

By V. S. YODER and HAROLD W. KEELER, JR., Resident Engineers



In 1913 the State of California constructed an up-to-date portland cement concrete highway traversing the valley between Santa Rosa on the south, and Healdsburg on the north. This 15-foot-wide "super highway" of the past served as an artery for traffic headed for the vineyards, the redwoods, and the Pacific Northwest. Later designated as U.S. 101, the road crossed the fertile flood plain of the Russian River for a few miles, and bridged the river on the southerly outskirts of Healdsburg.

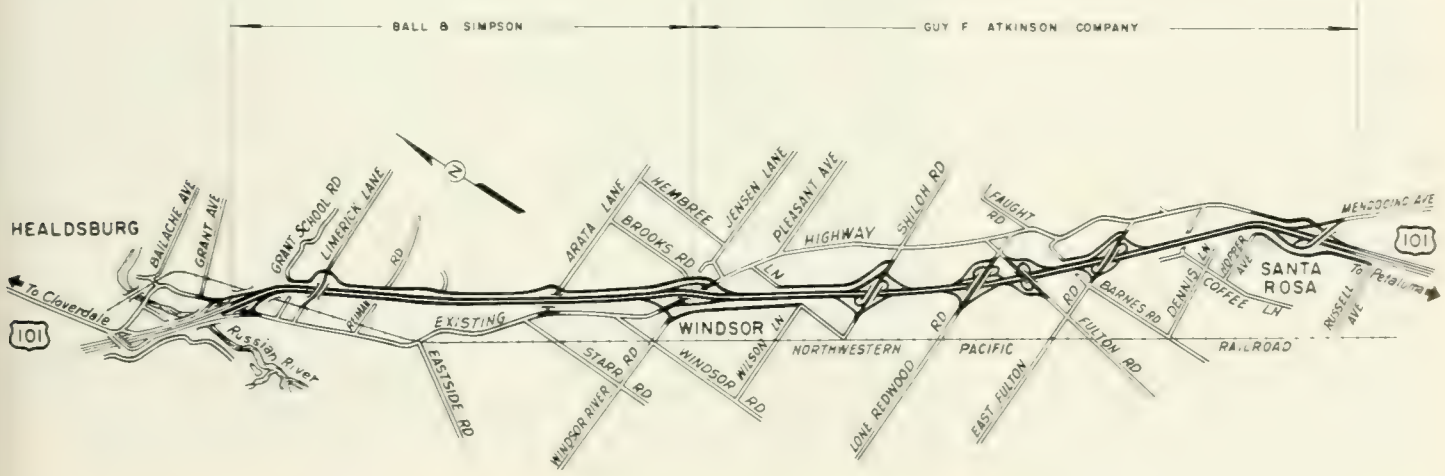
In 1926, in answer to the demands of progress, the Division of Highways refurbished the highway by resurfacing and widening to 20 feet. The area alongside built up with businesses, orchards were planted, and still the traffic grew. By 1960, traffic on this major north-south artery had begun to back up in the first symptoms of a grinding halt. Drastic action was required, and so two contracts were let to replace the now obsolete facility.

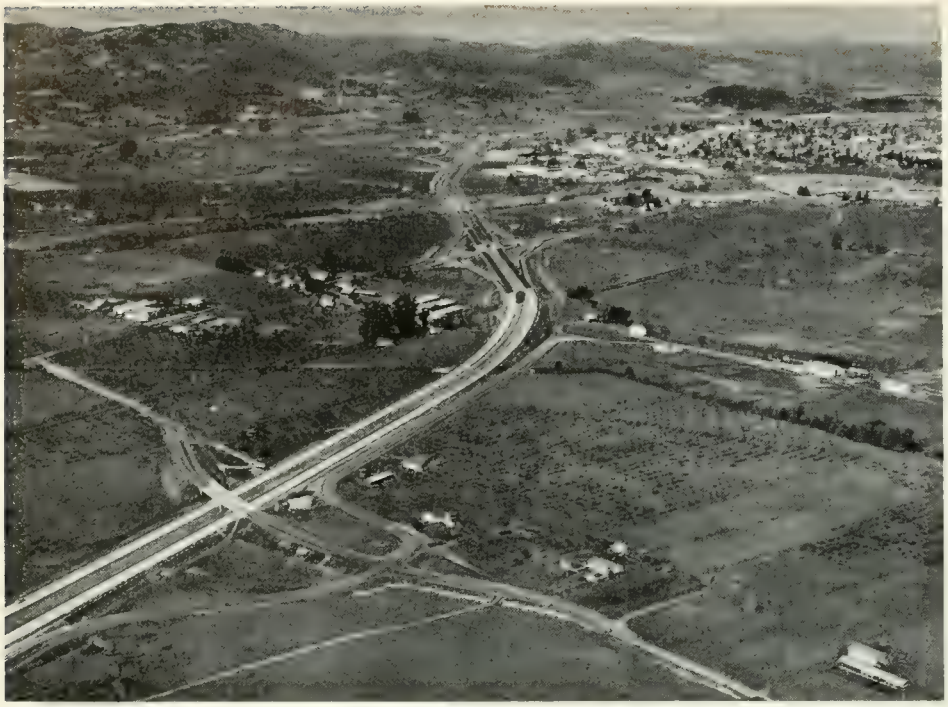
Join Existing Expressway

These two contracts joined the existing four-lane divided expressway at



PHOTO ABOVE. Fulton Road and Lone Redwood Road interchanges on the recently completed portion of U.S. 101 between Santa Rosa and Windsor. Mark West Creek in center. MAP BELOW. The freeway construction extended from Santa Rosa to south of Healdsburg.





Approaching Healdsburg from the south—Limerick Lane overcrossing in the foreground.

the northern outskirts of Santa Rosa with the recently completed four-lane freeway near Healdsburg, and were built on completely new and slightly skewed alignment with relationship to the old road. The first contract, let to the Guy F. Atkinson Company of San Francisco, started at the Santa Rosa end, and was located west of the old road to a northerly junction with the second contract near Windsor. At this point, the new freeway was separated from the old road by the Windsor Undercrossing, and the second contract was let to Ball and Simpson of Berkeley, who completed the freeway from that point to the Healdsburg end on the east side of the old road.

Now, after two years of construction, these two contracts have opened to traffic within a month of each other, and a severe bottleneck has been eliminated.

Santa Rosa-Wheeler

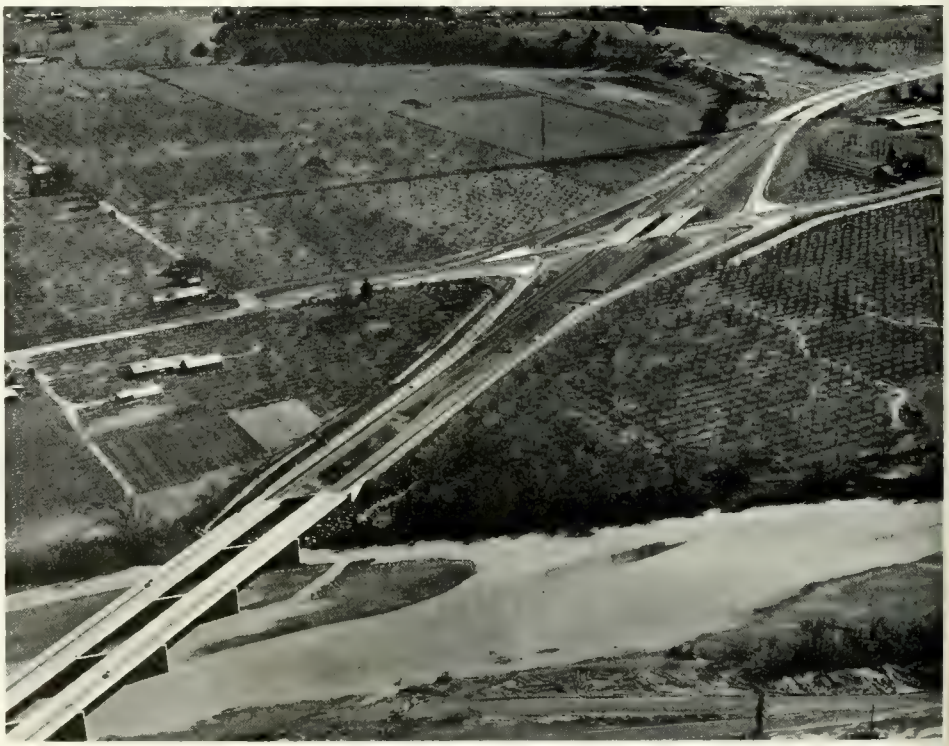
This contract for the construction of 6.3 miles of four-lane divided freeway, was awarded to the Guy F. Atkinson Company on August 2, 1960. Plans called for four lanes of portland cement concrete complete with appurtenant asphalt concrete frontage roads, and ramps. Interchange facilities were to be constructed at Mendocino Avenue, East Fulton Road, Fulton Road, Redwood Road, Shiloh Road and Windsor Road. There were additional structures included in the contract, bringing the total required to 14.

Work was somewhat complicated by the necessity of obtaining imported borrow for the approach fills to separation structures. This material came from excavation within the roadway prism cut through a hill located midway of the next contract to the north.

Difficulties were encountered in curing a troublesome slide which interfered with construction in the vicinity of Mendocino Avenue, and a protracted strike during the early part of 1962 had an adverse effect on this job, as it did on all work in Northern California. In consequence of these troubles, contract time was extended and the job completed on December 5, 1962. The total construction cost of the work was $4,530,000.

On this contract the portland cement concrete pavement was placed by the slip-form paving method. The types of equipment and the construction methods used were similar to those described in the September-October 1962 issue of *California Highways and Public Works* in the article entitled "Slip-form Job Fresno," with two exceptions.

First, the class 2 aggregate subbase was placed in windrows at a predetermined rate from bottom dump truck



Looking southerly to the newly constructed Grant Avenue Undercrossing and Grant Overhead. The Russian River is in the foreground.

and trailers, spread to grade with motor graders, and finally trimmed to a true grade with an "automatic roadbuilder." This machine made a path approximately 12 feet wide and operated from an automatic controlling device guided by an offset wire set to grade line. The subsequent passes made were controlled from the first pass by means of a control arm guided by a pilot wheel which rode on the grade previously cut.

Second, in constructing the portland cement concrete pavement, a recently adopted finisher was used, following from 100 to 150 feet behind the two transverse trailing bump cutters. This finisher was nearly identical with the first two transverse bump cutters attached to the paver, with the exception that it was self-propelled.

The average profile index on this contract was well within specifications and a very satisfactory riding surface was achieved with moderate grinding.

Windsor-Healdsburg

The second of the two contracts was awarded on December 27, 1960, to Ball and Simpson of Berkeley. Construction features were similar to the first contract except that only nine bridges were to be constructed.

This contract extended the freeway for another four miles. Methods differed somewhat, however, as both subbase and cement-treated base were cut to grade with an "automatic roadbuilder." The paving machine which spread and finished the portland cement concrete was also automatic and operated off two taut piano wires held at predetermined offset line and grade from the edges of the concrete slab. As on the adjoining contract, a pair of six-inch light aluminum floats were manually operated behind the paver to improve finished smoothness. Exceptionally smooth riding surface was achieved with practically no grinding except on hand-finished plugs at bridge approaches where the automatic equipment could not operate.

Soft foundation materials were indicated in the preliminary borings in Grant Undercrossing area and the contract required surcharging the abutment fills at this site with 10 feet of additional embankment which was to remain in place for a maximum of 90 days. The full period was utilized and nearly three feet of settlement in the embankments was recorded on the settlement devices which were the water-level type.



Looking north to Bell Mountain and Bald Hills from the Mendocino Avenue Interchange—Unstable hill mass on right has been stripped to forestall maintenance problems.

This area was a portion of the prehistoric Russian River bed and a frequent flood plain in recent times. As much as eight feet of water over the old highway during floods is recalled by local residents. Nearly 30 feet of soft loam overlies denser layers of gravel and sand. The loam acted as a sponge and compressed under fill loading. No "rebound" was noted upon surcharge removal.

Two Interchanges Included

Only two interchanges were included in this contract, one at Windsor Undercrossing where the freeway crossed to the east over the old highway between historic East and West Windsor and again at Grant Undercrossing where the freeway crossed back over west of the old highway again. Local residents east of the freeway were served by a continuous new frontage road nearly four miles long extending from just north of Limerick Lane southerly past Arata Lane to which it connected and thence to the old highway at Windsor. Limerick Lane was carried over the freeway and maintained connection to the old highway. The Arata Lane connection to the old highway was continued by constructing the freeway over this county road.



Northwesterly to Healdsburg from Windsor. The old Redwood Highway passes under the freeway at Windsor Interchange.

Ball and Simpson started their contract on January 4, 1961 and completed it on November 9, 1962, at a total cost of $2,831,000.

The two contracts discussed above in this article are actually the last two units of four used to provide full freeway from north of Healdsburg to Santa Rosa.

The first, completed in May, 1959, provided a new crossing over the Russian River bypassing the old inadequate structure upstream nearer town. The second unit, a bypass of Healdsburg, was completed in December 1960. The last two units provided full freeway between Healdsburg and Santa Rosa. In all, approximately $11,343,000 was spent for construction alone in providing for this 16.5 miles of freeway in Sonoma County.

The south project with Guy F. Atkinson Company had several superintendents. John Skeels was the last to be assigned and completed the work. State's resident engineers also changed during the project with Philip D. Auchard in charge at the beginning of the work and Harold W. Keeler, Jr., at the end.

The north project with Ball and Simpson also had several superintendents. Frank Fries started the project and G. Bruce Casten completed it. Vincent S. Yoder was resident engineer for the project.

Both projects were under the general supervision of George Beckwith until his retirement late in 1961 when Hal K. Taylor assumed his position as construction engineer.

Traffic Expert Webb Will Retire May 1

George M. Webb, Traffic Engineer for the California Division of Highways for nearly 10 years, will retire from state service on May 1, 1963.

From May 1953 until December 1962 Webb was in charge of traffic engineering functions for the Division of Highways. In December he was succeeded as traffic engineer by George A. Hill and was assigned to new duties in charge of special research projects.



GEORGE M. WEBB

Webb achieved national prominence in the traffic engineering profession through service on numerous nationwide committees. He is the author or coauthor of more than a score of widley published articles and reports.

For each year of this service as traffic engineer, California won or tied for first place in traffic engineering achievement in the nationwide inventory of traffic safety activities sponsored by the National Safety Council.

Born in Prineville, Oregon, Webb was educated in that state and went to work for its highway department in 1919.

He joined the California Division of Highways in 1928. From 1929 to 1937 he was resident engineer on projects in north central and northeastern California.

From 1938 to 1942 Webb was assigned to District I in Eureka. He then transferred to Sacramento, where, except for 2½ years as an officer in the Army Transportation Corps during World War II, he served in the Traffic and Planning Departments until his promotion to traffic engineer in 1953.

Webb is a member of the Institute of Traffic Engineers and an Associate Member of the American Society of Civil Engineers. His fraternal affiliations include the Masons and Shrine

Road Conference

I.T.T.E. Meet Stresses Research, City Problems

The problems of increasing urbanization and the compelling need for accelerated and expanded research were the most frequently discussed themes at the 15th Annual Street and Highway Conference, sponsorde by the Institute of Transportation and Traffic Engineering, at the University of California, Los Angeles, January 24-26.

The conference was attended by approximately 550 street, road and traffic engineers of cities and counties, by state and federal highway experts, and by representatives of consulting firms, material suppliers, automobile associations and transit organizations.

New Approach Needed

The first speaker, Burton W. Marsh, director, traffic engineering and safety department of the American Automobile Association, Washington, D.C., said that the days of satisfactory rule of thumb, trial-and-error attack on highway problems have gone forever.

Referring to the growth in traffic volumes and city populations, Marsh told attendees that highway officials must grow in knowledge with the problems that confront them and "be prepared with more mature, more complex and more sophisticated solutions."

Senator Randolph Collier, Chairman of the Senate Transportation Committee, who followed Marsh, spoke of the urgency of obtaining financing for proposed select systems of city streets and county roads during the present session of the Legislature.

The select systems would provide connections between major traffic generators and freeways and lateral movement between freeways, and would afford substantial traffic relief to state highways.

Study Areas Described

California State Highway Engineer J. C. Womack described the accomplishments and study areas of the American Association of State Highway Officials research program. Womack is immediate past president of AASHO.

1964 List Prepared

The list (of research projects for 1964) which is now being prepared for submission to the member state highway departments for balloting consists of 19 project proposals grouped into seven problem areas.

"It is interesting and significant," Womack said, "that the proposed 1964 program includes a total of eight proposals directly related to urban transportation."

He also outlined the problem areas that will be studied in 1963 and promised that the benefits of the research program would be shared with officials of cities and counties, principally through the day-to-day working relationships between the district offices of the Division of Highways and the street and highway departments of local governments.

Unit Renaming Significant

Indicative of the urbanization taking place throughout California, said State Director of Public Works Robert B. Bradford, is the fact that the section of the Division of Highways formerly known as Highway Planning Survey has been renamed the Urban Planning Department.

"The broad problem of urban transportation is rapidly becoming as familiar to the highway engineer as the problem of getting out of the mud used to be," Bradford said.

"Every week of the year there are conferences among state highway planners, city traffic engineers, county engineers and road commissioners, and the several public and private transit engineers and planners.

"Increased capacity of streets and highways and increased capactiy of mass transit are both 'musts' in California. Neither the private automobile,



The use of special bus-loading facilities on freeways to help solve the problems of mass transportation in urban areas was one of the topics covered at the 15th Annual Street and Highway Conference, sponsored by the Institute of Transportation and Traffic Engineering, January 24-26.

nor the bus, nor the train, is the sole and exclusive answer to our transportation needs. Only the rank amateur or the special pleader in the transportation field would argue otherwise."

1980 Predictions

Predicting 17 million motor vehicles in the state and a total of 200 billion vehicle miles of travel by 1980, Bradford claimed that there will be less traffic congestion on the freeway and expressway system then than exists today.

The U.S. Bureau of Public Roads was represented at the conference by Robert F. Baker, director of the Office of Research and Development, who hailed the trend toward a true interdisciplinary approach to highway problems.

"Any self-respecting researcher has always looked to other areas of science for assistance," he said. "However, the mushrooming highly technical, highly specialized nature of our understanding of people, machines, and nature makes it increasingly more necessary to enlist the help of specialists.

Researchers Becoming Aware

"Highway researchers are also becoming more aware of the need of psychologists and their understanding of human behavior. Our present geometric design principles do not directly relate to the capabilities and limitations of the human. Furthermore, the tremendous variations between drivers and between the same drivers at different instances in time suggest the difficulties in achieving geometrically accurate grades and curves."

Former U.S. Commissioner of Public Roads Ellis Armstrong, now a consulting engineer, expressed his confidence in the wisdom of Mr. John Q. Public when he is given the facts upon which to act. He stressed the public relations need of keeping him informed and cautioned highway officials to listen and react constructively to his opinions.

Other Speakers

Other speakers at the general sessions were James Bell, professor of Government and Public Administration, Sacramento State College, who spoke on the "Human Side of Management"; Thomas Fletcher, city manager, San Diego, whose topic was "Decision Making in Government"; and William Hurd, deputy assistant administrator for transportation, U.S. Housing and Home Finance Agency, "Mass Rapid Transit in Urban Areas."

"Each community must study, decide and express for itself," said Hurd, "its goals, its program for community development, its preference for arrangement, and its desired system for balanced transportation to serve its growing and changing population. This planning process, to meet the standards of both current and contemplated federal programs of urban assistance, must be communitywide or regional in scope—not piecemeal nor unrelated to comprehensive planning."

Joseph Havenner, general manager, Automobile Club of Southern California, and C. M. Gilliss, executive director, Los Angeles Metropolitan Transit Authority, discussed the points raised by Hurd.

Community Desires Stressed

Havenner criticized the stressing of "balanced" transportation planning. He said that the proper role of the urban planner is to fulfill the desires of those in the community and to protect the community from those few who would exploit it.

Gilliss asked for clarification of the terms, "rapid" and "mass" transportation and "carrying capacities," as used in federal directives. He added that the amount of money from federal sources for mass transportation in Los Angeles County would be but a very small fraction of the money needed for the 58-mile system of rail rapid transit proposed by the Los Angeles MTA.

The conference ended at a luncheon meeting at the Hollywood Roosevelt Hotel which was addressed by William Randolph Hearst, Jr., chairman of the President's Committee on Traffic Safety, who urged the adoption of uniform traffic rules throughout the nation.

Workshop Sessions

Following the morning general meetings, delegates attended workshop sessions on street and highway planning, design, construction, financing, materials testing and traffic control.

Division of Highways personnel who were members of workshop panels or who presented papers were Charles T. Ledden, engineer of city and county projects, and H. H. Deardorff, assistant engineer of design (Street and Highway Standards; Design and Classification); Travis W. Smith, assistant materials and research engineer (Aggregates: Availability, Durability and Beneficiation); Roy W. Matthews, assistant traffic engineer (Control of Signalized Intersections Adjacent to Railroads);

R. J. Israel, assistant traffic engineer (Organizing for Uniform Application of Signs, Signals and Markings); George B. Sherman, assistant materials and research engineer (Report on AASHO Road Test); A. L. Himelhoch, district engineer for operations, District VII (Critical Path Method of Scheduling);

Patching, Sound Studied

Herbert A. Rooney, senior chemical testing engineer (Use of Epoxies for Patching); M. L. Bauders, city and county project engineer, District VII (Efficient Use of Existing Widths of Streets and Highways); Louis Bourget, acoustics engineer (Sound Emanation from Highways);

William G. Weber, Jr., associate materials and research engineer (Nuclear Devices for Determination of Moisture and Density); Francis N. Hveem, materials and research engineer (Records Sampling); Richard F. Stratfull, associate materials and research engineer (Field Methods of Detecting Corrosive Soil Conditions) and Karl Moskowitz, assistant traffic engineer (Traffic Clinic).

Other workshop sessions studied assessment districts, the construction of the much-talked-about Pomona Mall, materials laboratories for smaller cities and counties, and the planning of a pavement maintenance program.

83-Mile Route

Newly Adopted Freeway Locations Include Long Stretch in Desert

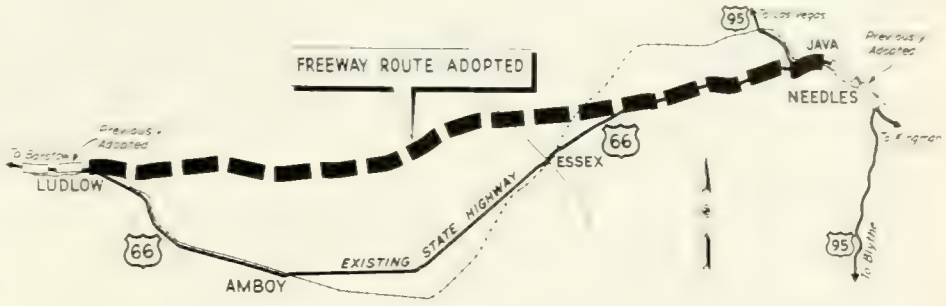
During its January and February meetings the California Highway Commission adopted freeway routings for 12 sections of highway in various parts of California totaling 166.6 miles. The longest route adopted was for 83 miles of U.S. 66 in San Bernardino County.

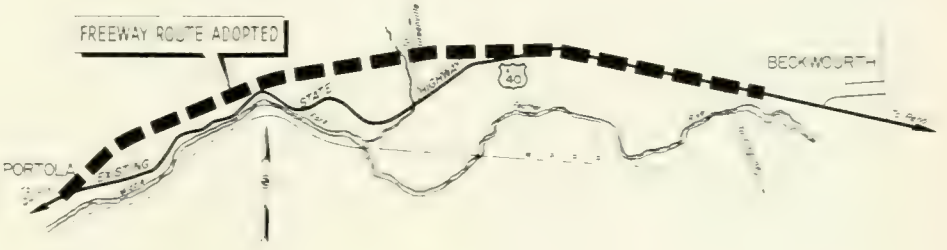
Three of the freeway route adoptions were on the basis of public hearings held by the commission. In two of these, a route for State Highway Route 229 in San Mateo County and a portion of the Glendale Freeway in Los Angeles, the commission followed the recommendation of State Highway Engineer J. C. Womack. In the third, a route for 8.1 miles of U.S. 99W in Colusa County, the commission adopted a route differing from that recommended.

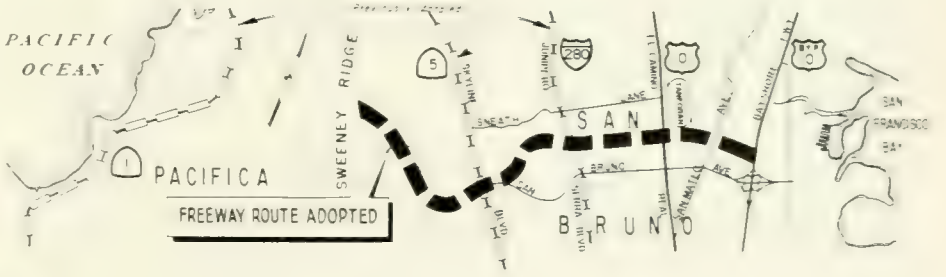
The commission also adopted conventional highway routings for a section of Sign Route 36 in Trinity County, a portion of State Highway Route 35 in Trinity County and for a short portion for Sign Route 20 in Willits to connect existing U.S. 101 with a new freeway routing for that highway.

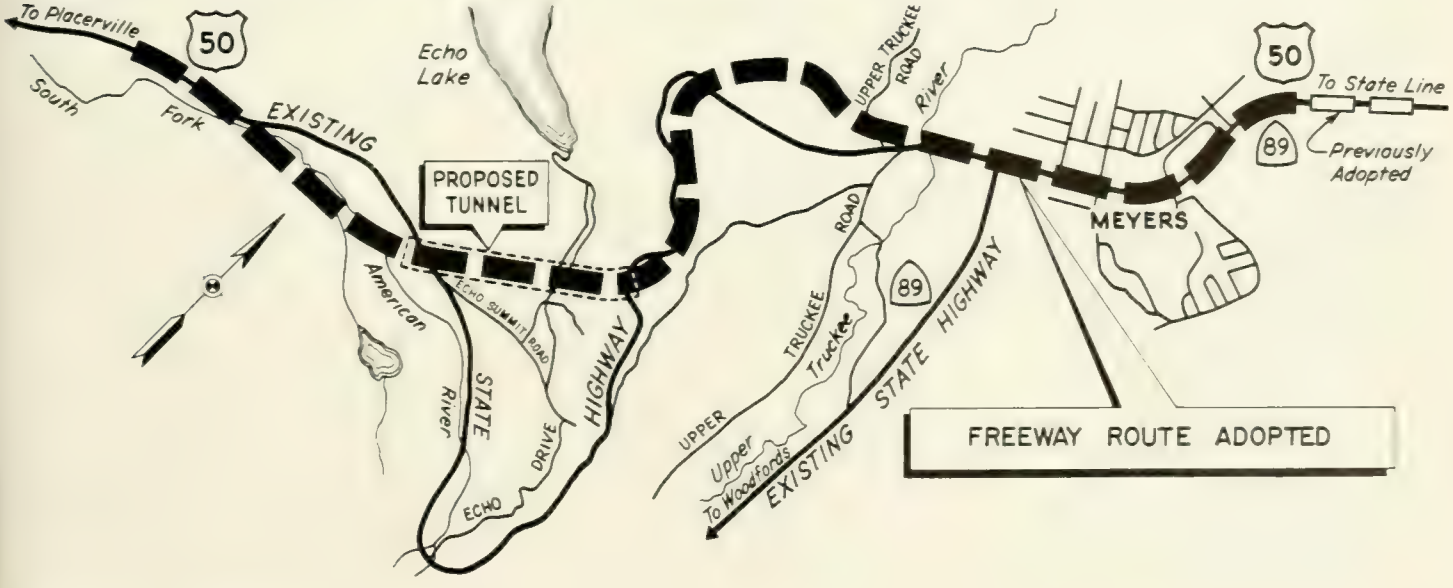
Freeway routes adopted:

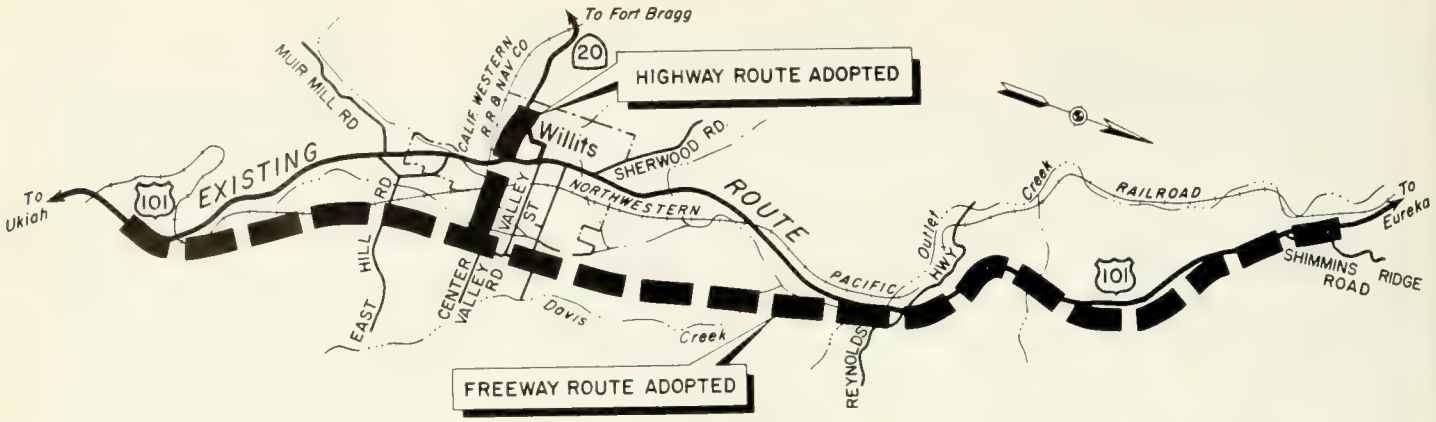
Colusa County—for 8.1 miles of U.S. 99W (Interstate 5) between the

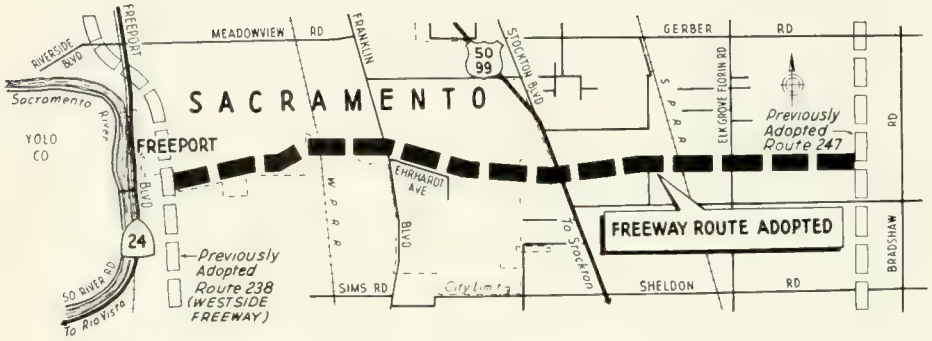


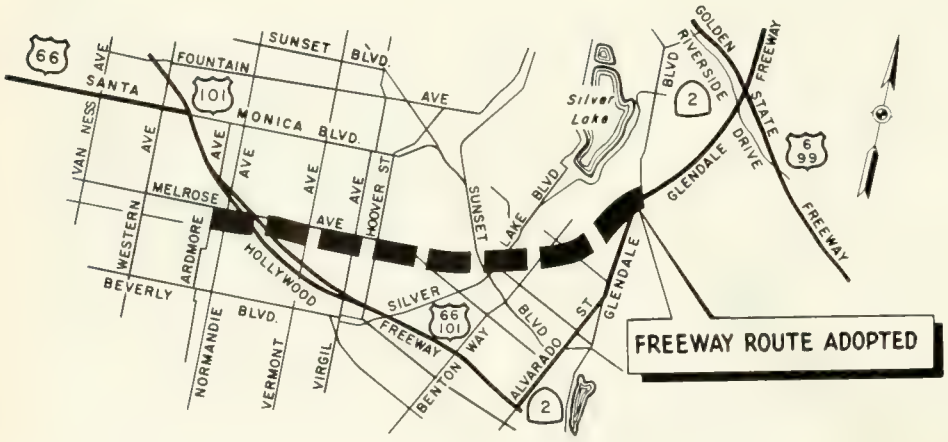


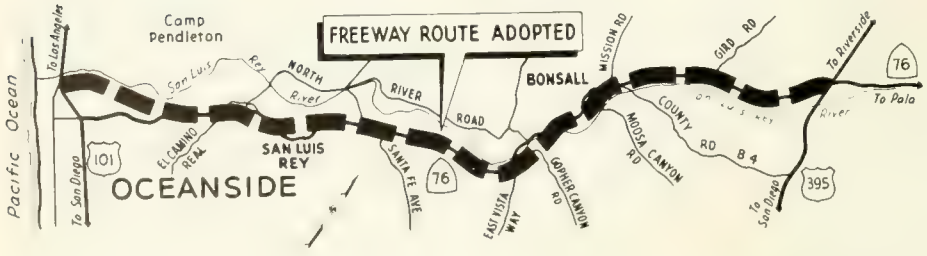












adopted freeway route for Sign Route 20 near Williams and Colusa-Maxwell Road.

El Dorado County—for 5.7 miles of U.S. 50 in the Echo Summit area between 0.5 mile east of Phillips and Meyers.

Inyo County—for 14.2 miles of Sign Route 190 between Panamint Springs and the west boundary of Death Valley National Monument.

Los Angeles County—for 2.7 miles of the Glendale Freeway (State Highway Route 162) in the City of Los Angeles between Ardmore Avenue and Glendale Boulevard.

Mendocino County—for 12.2 miles of U.S. 101 (Redwood Highway) between 0.5 mile north of the Northwestern Pacific railroad crossing south of Willits and 0.4 mile north of Reeves Creek.

Plumas County—for U.S. 40 Alternate (Feather River Highway) between the east city limit of Portola and 0.7 mile west of Beckwourth.

Plumas County—for five miles of Sign Route 89 between 1.3 miles northwest of Almanor and Sign Route 36.

Sacramento County—for 9.1 miles of State Highway Route 248 (South Belt Freeway) in and near the southern part of Sacramento between the adopted route of the Westside Freeway near Freeport and the adopted route for State Highway Route 247 northeast of Elk Grove.

San Benito County—for two miles of Sign Route 156 between U.S. 101 and 0.3 mile west of San Juan Bautista.

San Bernardino County—for 83 miles of U.S. 66 between two miles east of Ludlow and Java, just east of Needles.

San Diego County—for 16.8 miles of Sign Route 76 between U.S. 101 in Oceanside and U.S. 395 near the San Luis Rey River.

San Mateo County—for four miles of State Highway Route 229 in Pacifica and San Bruno between Sweeney Ridge and the Bayshore Freeway.

Bridge Costs

1962 Average Shows Moderate Increase

By H. K. MAUZY, Senior Bridge Engineer and
W. J. YUSAVAGE, Associate Research Technician

The annual average level of bridge construction costs increased moderately during 1962. The construction cost level at the close of 1961 was 273 and, during the subsequent four quarters, showed successive quarterly values of 264, 288, 274 and 264, or an average annual value of 274. The corresponding annual average value for 1961 was 264, or one which indicates that bridge construction costs increased by 3.8 percent during 1962.

The array of successive quarterly values, 264, 288, 274 and 264, indicates that the tendency toward a greatly accelerated rate of increase in construction costs was especially strong during the second and third quarters and diminished perceptibly during the fourth quarter.

The level of costs as well as the trends of other relevant construction data are presented in the accompanying chart which summarizes the data of California bridge construction activity since 1934.

Construction Activity

The annual outlay for bridge construction attained a maximum value of 128 million dollars during 1960, a year during which a large backlog of projects was carried forward from the previous year. During 1961 the value of expenditures dropped to the more "normal" level of about 85 million dollars. The value of bridge construction was reduced to $72 million during 1962. The value of expenditures for bridge construction during 1963 is expected to rise to within the more "normal" range of $85 million.

Bidder Activity

Bidder activity was significantly curtailed during 1961 and during the first three quarters of 1962. A resurgence in bidder activity developed during the fourth quarter of 1962 when an average of 7.1 bidders competed for 28 projects. The total number of bids submitted for 125 projects in 1962 was 750 or an average of 6.0 bidders per project. The corresponding figures for 1959, 1960, and 1961, were 8.8, 7.3 and 5.8. The averages show that the intensity of competition was decidedly falling off during the past three years and that there was only a slight improvement noted during 1962. Declines in the rate of bidder activity are generally associated with rising bridge construction costs. Bridge costs followed this pattern during 1961 and 1962; they increased by about 6.5 percent in 1961 and 3.8 percent in 1962.

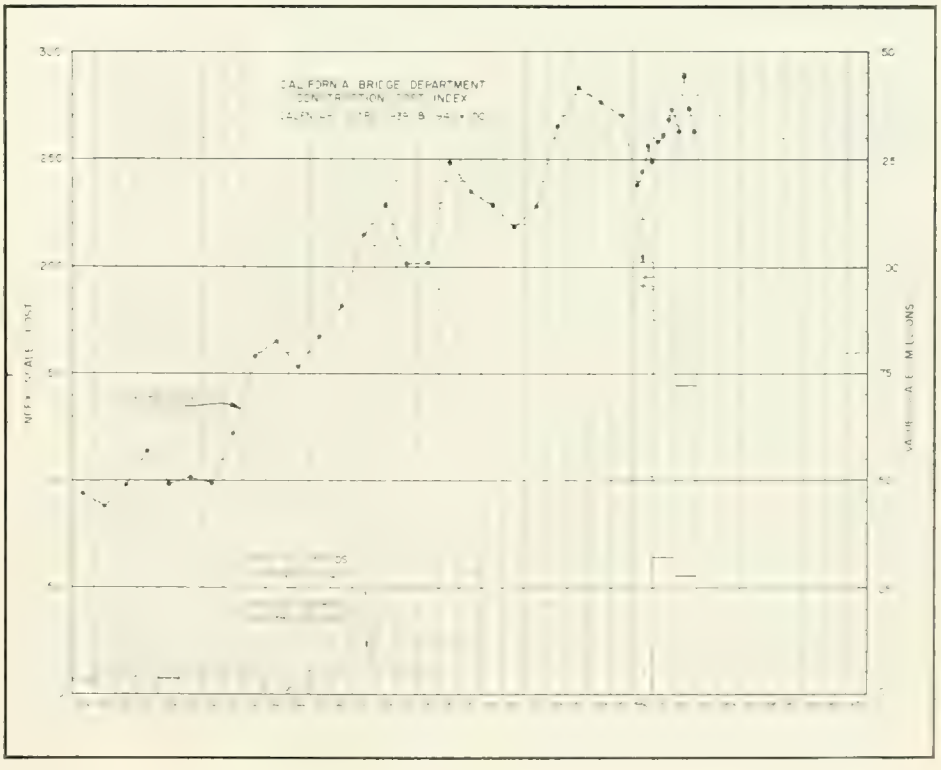
Average Unit Prices

The weighted average unit price of most bridge construction items increased moderately during 1962. The prices of a few of the more significant items have developed trends which are described as follows:

Class A Portland Cement Concrete. The weighted average unit price of the item was in decline for the three years following 1957 when it reached a peak of $58 per cubic yard. The price dropped to $55 per cubic yard in 1958, to $52 in 1959, and to $50.60 in 1960. The trend was sharply reversed in 1961 when the unit price increased to $56 per cubic yard. The trend was then carried forward to 1962 with a further increase to $59.15 per cubic yard.

Bid quotations for class A concrete during 1962 were generally in the range of $55 to $65 per cubic yard.

Bar Reinforcing Steel. The trend of unit prices for bar reinforcing steel prices is unique in that it dropped to early 1950 levels in 1960 and has shown no appreciable change from the reduced level. The weighted average unit prices during 1958 and 1959 were $0.124 and $0.113 per pound. During



1960 the price dropped to $0.097 per pound and, in 1961, dropped further to $0.094 per pound. The weighted average unit price during 1962 was $0.092 per pound.

Structural Steel (Plate Girder). The weighted unit average price of structural steel has shown a slow but persistent creep upward. The corresponding unit prices for the four years 1958, 1959, 1960 and 1961 were $0.164, $0.163, $0.169 and $0.173 per pound. During 1961 the average unit price increased to $0.184 per pound. The foregoing average prices reflect the cost of plate girders with A-7 or A-373 structural steel. Other types of structural steel such as A-441, A-36 and A-242 have not been used at a frequency which would yield sufficient price data to develop a reliable average unit price.

Prestressed Concrete. The summary unit price of prestressed concrete is expressed in terms of the price of a composite cubic yard in place. The unit price accordingly includes the cost of concrete, reinforcing steel, stress steel, anchorages, prestressing operations, as well as the cost of erection.

The corresponding weighted average prices per composite cubic yard of prestressed concrete for the years 1955 to 1961, inclusive, are $135.27, $163.03, $164.48, $144.74, $134.94, $138.97 and $150.22. During 1962 the weighted average unit price fell off moderately to $145.96 per composite cubic yard. The foregoing average prices reflect the cost of the various forms of prestressed construction including precast prestressed members such as the "I", "T", and box girder, and the cast-in-place post-tensioned type of construction. An analysis of the average unit prices of the "I" girder which is the most frequently used type of prestressed construction shows a weighted average cost of about $170 per composite cubic yard with a plus and minus variation of about 25 percent. The corresponding cost of cast-in-place post-tensioned construction is about $130 per composite cubic yard.

In combination the foregoing items comprise about 75 percent of the total annual cost of bridge construction. At the current rate of demand a change of 3 percent in the weighted average unit cost of the four items implies a gain or loss to the bridge construction program of about 1.7 million dollars. The advantage of competition is clearly demonstrated in the example of the item, bar reinforcing steel, which during the past three years was sold at about $0.02 per pound less than the going rate of 1959. During these three years the bridge program required about 580,000,000 pounds of reinforcing bars which, at the reduced rate, afforded an economic advantage to the program of about $10 million.

Summary

An analysis of the general trend of bridge construction costs for the two years since 1960 shows a net increase of about 10 percent, with 6 percent of the increase occurring in 1961 and 4 percent in 1962.

Ferry "Real McCoy" Will Be Converted

The Department of Public Works has awarded a contract for $84,170 to Colberg, Inc., Stockton, for converting the ferry *The Real McCoy* from cable-operated to free running. The ferry which operates on Cache Slough from the mainland near Rio Vista to Ryer Island, was named after former State Highway Engineer G. T. McCoy.

Conversion of the vessel is necessary so that the cable now used across Cache Slough can be removed for operation of the Sacramento - Yolo Port District Deep Water Channel which is scheduled to open July 1. The cost will be met by the Port District under agreement with the Department of Public Works.

Ferry service will be maintained during the conversion period by the ferry *Scooter*, a reserve cable-operated vessel.

The Real McCoy will be diesel-powered, steered and driven by propellers amidship on both sides. It will be equipped with modern appurtenances, including radar.

Architecture Loses Construction Chief

Charles M. (Tex) Herd, 55, for nine years chief construction engineer for the State Division of Architecture, will retire April 30.

Herd heads the division's construction supervisory forces and is responsible for the review and approval of plans for structural adequacy of all public school buildings erected throughout the State.

State building projects worth nearly $700 million have been constructed under Herd's supervision.



CHARLES M. HERD

This is about two-thirds of the Division of Architecture's capital outlay program of public works during its entire 56-year history.

He was a supervising structural engineer in the Los Angeles and San Francisco offices of the schoolhouse section for a year and then principal structural engineer in charge of the San Francisco operation.

Herd is a native of Mangum, Oklahoma, where he attended grade school. He gets his nickname, "Tex", from high school days in Weslaco, Texas.

He came to California in 1925. He attended the California Institute of Technology for two years and then the University of Southern California, graduating in 1931 cum laude with a B.S. degree in civil engineering.

During World War II Herd served six years—three in the South Pacific—with the U.S. Navy Civil Engineers Corps. He is now a captain in the Naval Reserves.

Herd is a member of Tau Beta Pi, the American Society of Military Engineers, and the American Society of Civil Engineers.

In 1956 he served as president of the Structural Engineers Association of California.

Herd and his wife, Gladys, have a daughter, Mrs. Carol Herd deVallejo, who lives in Riobamba, Ecuador.

The Herds will live in San Francisco after his retirement.

29 Palms Interchange

New Construction Eliminates Intersection

By J. E. WALSH, Project Engineer



On December 29, 1962, the Twentynine Palms Highway interchange, which connects the Twentynine Palms Highway (Legislative Route 187) with a high-speed, high-volume interstate highway (Interstate Route 10), was opened to traffic, thereby eliminating another at-grade intersection from the state highway system in California.

Increased Traffic Volumes

Traffic volumes have increased on Twentynine Palms Highway in recent years due chiefly to the expansion of the "high desert" communities, along with the shuttling of military convoys between Camp Pendleton marine base at San Diego and the marine training center northerly of Twentynine Palms. Interstate Route 10 traffic volumes have also increased due to increased interstate travel and truck traffic transporting produce from the Imperial Valley to Los Angeles markets.

Ultimate Freeway Conversion

As Interstate Route 10 and Route 187 will both ultimately be converted to freeway standards, this interchange was developed to provide the high standards necessary for the transferring of traffic between freeways. Numerous alternate geometric designs were studied, with major consideration being given to the freeway-to-freeway traffic movements, economy, and land development.

Because they begin on long, straight, downhill sections, interchange ramps taking eastbound Interstate 10 traffic on to Route 187 northbound and southbound Route 187 traffic on to Interstate 10 westbound are designed for speeds in excess of 60 miles an hour.

Contour Grading

To add to the general appearance of the interchange, contour grading plans were prepared to provide for flat, well-rounded slopes blending in with the rolling desert terrain.

Interim Connections

Access to and from Interstate Route 10 for the adjacent lands was accomplished by designing frontage roads with an interim connection to Interstate Route 10 at the easterly terminus of the project. This connection will be eliminated and the frontage roads extended easterly when Interstate Route 10 beyond the limits of this project is converted to a full freeway.

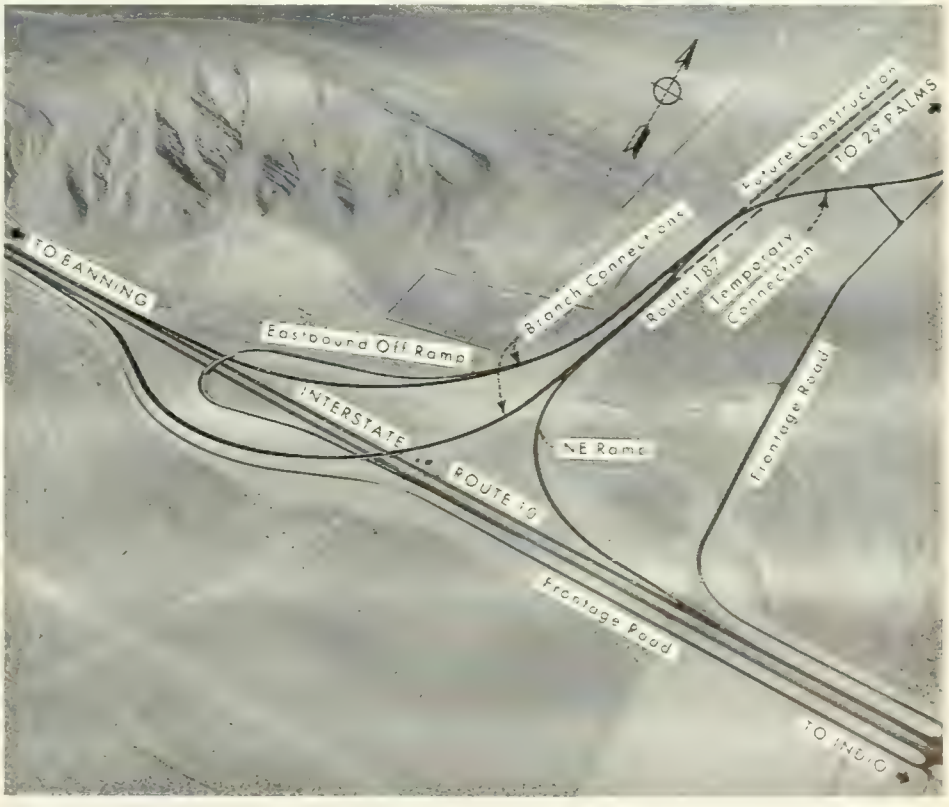
Temporary Connection

A temporary connection with existing Route 187 was provided for at the northerly limits of the project, with the future roadbeds "stubbed off," thereby providing for the future construction of Route 187 roadbeds without interfering with traffic. Plans are now being prepared for extending Route 187 on an expressway basis between the northerly terminus of this project and Dry Morongo Canyon.

Will Reduce Accidents

With the opening of this interchange to traffic, the high-standard, freeway-to-freeway connections should reduce, if not eliminate, the accident rate attributed to this location.

This project was constructed by the Massey Sand and Rock Company, Indio, under the supervision of J. O. Erwin, resident engineer, at a cost of $1,220,000, a portion of this cost being financed with interstate highway funds.



This aerial photo with superimposed text shows the design of the new interchange.

Sierra Sam

He Loses His Head During Test Crash

From Materials and Research Department's "Random Samples"

The first confirmed fatality in the structural materials section in the line of duty occurred Thursday, January 10, to an old and respected employee. This faithful civil servant had survived 30 passenger vehicle collisions and 2 bus collisions with no more severe injuries than multiple lacerations of the face and scalp, concussion, a squashed rib cage, fractured leg, shoulder, and arm, torn buttocks, third degree acid burns, and a broken heart.

Many Awards

For his services to the State of California above and beyond the call of duty and for accepting his responsibilities, he has received the following awards:

June 1958, Hero Medal; July, August, September 1958, Hero Medal Clusters; July 1960, Stubborn Medal with palms; June 1962, Idiot Medal; and January 1963, the coveted bronze Non Compos Mentis Medal, posthumously awarded.

Road to Success

For Sierra Sam the road to success in research has been beset with frustration (three aborted runs), jubilation (the success of the cable chain link barrier), and terror (the first 80 m.p.h. run on a bridge rail).

Sam's ancestry dates back to 1949 when the first semiarticulated anthropometric dummies were developed by the Air Force Aero-Medical Laboratory for highspeed seat ejection sled tests. Sam was born in January 1958, when he weighed in at 200 pounds and was certified for appointment from a personnel board list of two in May 1958.

Driver 'Disappointed'

The other eligible on the list for the position of senior crash car driver was Elvin "Kess" Kessinger, a bridge department employee who had driven the crash cars for the 1953 curb test series. "Kess" was at first disappointed that the Personnel Board bypassed him

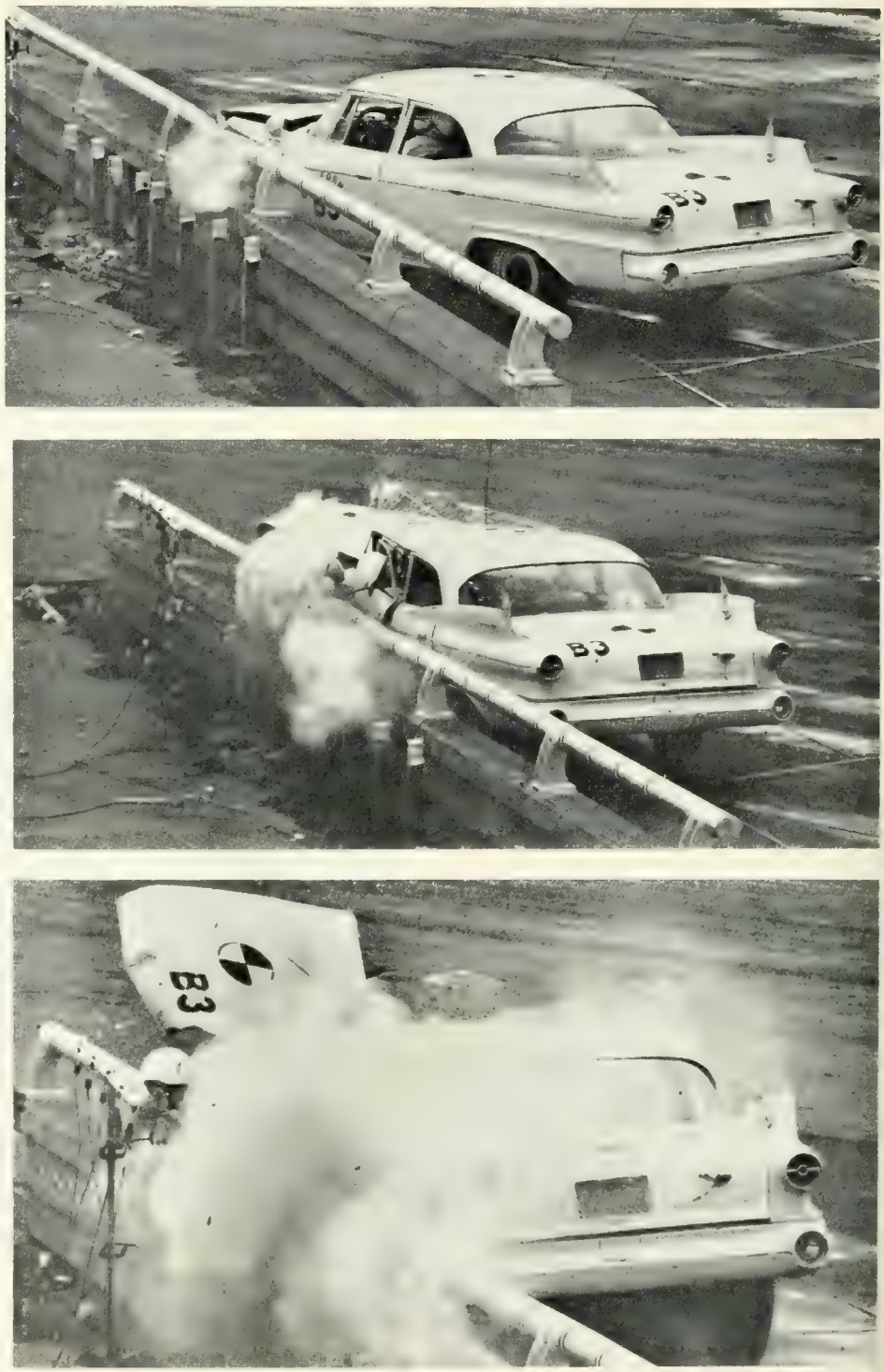


PHOTO SEQUENCE ABOVE of Sam's fatal ride shows him at point of impact (TOP), head protruding from window (MIDDLE) and head broken off and on its way at left of collision cloud (BOTTOM). Photos by Robert Souza.

in favor of Sam for this new high-speed series; however, he was more reconciled after witnessing the first collision test at 60 m.p.h. that resulted in a rollover and serious head injuries to Sam. On checking the Personnel Board records we find no evidence of "Kess" reapplying for this position.

Fine Figure of Man

Sam is anthropomorphic (features and body contours conforming in shape to those of the human counterpart) as well as anthropometric (weight distribution and locations of each part of the anatomy are correct for a 200-pound standard man).

No Remorse

There is no remorse that Sam lost his head (literally and figuratively) during the January 10 bridge rail test. His skull, protected by a new type Highway Patrol helmet, traveled over 100 feet airborne and rolled another 100 feet before comming to rest on the side of the test site runway.

Wounds Described

Other than decapitation (three high-strength steel bolts sheared in his neck joint), he suffered (rather his head suffered) only minor abrasions of the chin and nose.

Under the talented wrench of Dr. Don "Kildare" Hughes and the artistic brush of plastic surgeon Dr. Chuck "Casey" Ledbetter, Sam is once again intact, smiling, ready and able for the forthcoming bridge rail tests.

Reasons Sought

At this time we are unable to determine the exact cause of the decapitation; however, the two most logical contributing factors were the high deceleration (in excess of 40 g's) and the diagonal cross-chest shoulder harness restraint.

We feel sure the human counterpart would have sustained a broken neck under similar collision conditions.

Let this be a warning—Sam is repairable—*you* might not be!

A recent survey shows that California has 11 percent of all vehicles registered in the United States, 9 percent of the nation's population of driving age (16 and over).

H.R. 381 Study Groups Hold Region Meetings

Advisory study groups on motor vehicle and highway operations held regional meetings in March and April as one phase of a comprehensive study of the interrelationship of the citizen, his motor vehicle, and state government.

The meetings took place in San Diego, Los Angeles, San Francisco and Sacramento.

The overall study was initiated by the Legislature in 1959 as House Resolution 381. Part one, the factfinding phase of the study, was completed in January 1961 and describes how the State manages its highway "plant," how it regulates drivers and their vehicles, and how it enforces traffic laws.

In part two, the analysis and evaluation phase, study groups are meeting to consider five functional areas: motor vehicle registration and title, financial responsibility, driver licensing, highway patrol functions, and the operations of the Division of Highways.

At each regional meeting, registration and title, including occupational licensing and business regulation, were covered between 9 a.m. and noon of the first day, while financial responsibility and highway traffic operations were the subjects for the afternoon session (1.30 to 4.30). On the second day, the entire program was devoted to driver licensing. The final day covered the supervision and services of the California Highway Patrol.

Technical consultants and state officials were present at the regional meetings to take part in detailed discussions in each area of interest. The consultants and officials previously attended study guidance group meetings held in Sacramento during the winter.

Technical consultants for the various study areas are as follows: *Driver Licensing*—John C. Kerrick, Director of Driver Licensing Programs for the American Association of Motor Vehicle Administrators, Washington, D.C., Glenn V. Carmichael, Co-ordinator of Programs for the Traffic Institute at Northwestern University, Evanston, Illinois, and Anthony Antony, Research Analyst for the Automotive Safety Foundation, Washington, D.C.; *Financial Responsibility* – Milo W. Chalfant, Michigan State University; *Highway Patrol*—Robert E. Raleigh, Citizens Traffic Safety Board, Chicago; *Highway Traffic Operations*—David W. Schoppert of Alan M. Voorhees and Associates, Washington, D.C.; and *Registration and Title*—Louis R. Morony, Director, Laws Division, Automotive Safety Foundation, Washington, D.C.

Frank B. Cressy Leaves District VII

Assistant District Engineer Frank B. Cressy retired April 1, ending a career of nearly 36 years with the Division of Highways. All of his service has been with District VII, most of it in construction.


FRANK B. CRESSY

A native of San Francisco, Cressy joined the District in 1927, following his graduation from the University of California. During the next 14 years he was an assistant resident and a resident engineer on construction projects.

During World War II he served with the Navy in the Pacific theater. In 1948, he was promoted to captain in the Naval Reserve.

Cressy returned to Highways in 1946 as construction engineer. The following year he was promoted to supervising highway engineer.

Cressy and his wife, Opal, have a married daughter, Diane, two teenage sons, Frank B. and Richard S., and two grandchildren. The Cressys recently built a home in Thermal, California, near the Salton Sea.

He served as a director of the La Habra Heights Mutual Water Company from 1949 until 1956 and was a member of the advisory council, Calavo Avocado Growers, for several years.

Twenty-five-year List

The following employees received their 25-year awards during January, February and March:

Headquarters Office
Vivian E. Brady
George H. Ebenhack
Arthur E. Mertens
Robert L. Zehrbach

Bridge Department
James G. Standley, Jr.
Herbert W. Gee

State-owned Toll Bridges
Clair Gibson
Edith Thoms Harrell

District I
William Z. Hegy
George W. Lockwood
Howard L. Nelson

District II
Laures H. Fretts

District III
Eldon C. Patchell
Clyde F. Moeckly

District IV
Charles P. Carter
Ralph B. Keller
E. J. Stewart, Jr.

District VII
Alfred R. Finch
Chester W. Gish
Wasson E. LaBrande

District VIII
George E. St. Jean

District IX
Pete Minaberry, Jr.

District X
Hannah M. Henderson
Maxine A. Nolton

District XI
Jacob Dekema
Samuel Solomon
Hubert B. Whitnall

New Transbay Study Shows Bridge Need

Additional bridges to connect San Francisco with Alameda and Marin Counties are urgently needed, according to Norman C. Raab, chief of the Division of San Francisco Bay Toll Crossings.

Raab's report, addressed to the State Director of Public Works, had been requested by the Legislature in 1961.

The report was based on extensive origin and destination studies conducted in 1961 and on projected traffic increases that will cause the San Francisco-Oakland Bay Bridge to reach its maximum capacity in 1965 and the Golden Gate Bridge in 1967.

Although specific routes for the two bridges were not proposed, the report considered for study purposes a Potrero Point crossing from the foot of 20th Street in San Francisco to Alameda, and a bridge from near Telegraph Hill in San Francisco to the Tiburon Peninsula in Marin County via Angel Island.

The report also considered a Sierra Point crossing from the San Mateo county line near Brisbane to Alameda County near Hayward, but found that it offered far inferior traffic service than the more northerly one from 20th Street.

The report based on analysis of traffic data by Coverdale and Colpitts, consultants, stated that if the new crossings are not constructed, many vehicles will be diverted to the Dumbarton and San Mateo-Hayward bridges when the San Francisco-Oakland Bay Bridge reaches its 45 million annual vehicle limit in 1965. The Dumbarton Bridge will reach its maximum capacity in 1970 and the San Mateo-Hayward Bridge in 1980. Many motorists will then choose to drive the freeway route around the south end of the San Francisco Bay.

He added that the Golden Gate Bridge's annual capacity of 25 million vehicles will be exceeded by 3.4 million by 1980.

"KIDPROOF RAILINGS" PRAISED

March 2, 1963

EDITOR
California Highways and Public Works
P.O. Box 1499
Sacramento, California

DEAR SIR: Your publication has been very valuable to me in my teaching. Last year when I was studying the highways of California with my fourth-grade class, I found, in my back issues of *California Highways*, pictures to illustrate all phases of highway construction. This made a most meaningful experience for my students as we were able to consider the complicated process of highway construction from the first planning to the road dedication.

Recently I found good use for the article called "Kidproof Railings" which appeared in the September-October 1962 issue of the magazine. It served as the basis for a lesson with my students regarding respect for public property and our responsibility in regard to taking care of this property. The author of that article, by the way, should be congratulated for the interesting and lively way in which he presented his cause! He certainly aroused my sympathies and he might be interested to know that my students were quite shocked and very sympathetic when told of this problem and as we discussed others of its kind.

I am now in the process of preparing some materials for use by other teachers, and wonder if I might have two more copies of that issue of the magazine so that I can mount the pictures for study.

Sincerely,

MRS. JAMES H. FRETZ
Valley View School
East Whittier City
School District
Whittier, California

The Department of Public Works advertised for bids in March for 55 highway projects with an estimated value of $18,990,300. There were 36 contracts awarded for $30,609,700 and 33 contracts for $19,088,600 completed.

Recent Retirements From Division Are Listed

Headquarters Office

Edward F. Carter, senior highway engineer, 43 years; William B. Carter, assistant highway engineer, 25 years; William S. Cully, assistant comptroller, 32 years; Charles V. Gay, associate statistician, 26 years; Guliano Evangelista, laborer, 11 years; Merle A. Lapham, senior file clerk, 15 years. Lewis Ora Holsey, laborer, 10 years.

Bridge Department

George A. Greene, senior bridge engineer, 32 years; Loretta Turpen, supervising account clerk I, 32 years; Carroll C. Winter, supervising bridge engineer, 32 years.

Materials & Research Department

Harry F. Kuhlman, associate steel inspector, 33 years; William E. Haskell, associate materials and research engineer, 24 years.

Headquarters Shop

Thomas A. Mendenhall, highway equipment superintendent I, 41 years; Earl E. Sorenson, principal equipment engineer, 34 years; Edgar M. Burgess, heavy equipment mechanic, 23 years; Paul G. Howard,* supervising machine parts storekeeper I, 14 years.

District II

Virgil B. Cade, highway maintenance man II, 25 years; Clyde F. Robinson, highway maintenance man II, 14 years; Mortimer E. Beaty, associate highway engineer, 21 years.

District III

George I. Stancil, highway maintenance man II, 29 years; Henry R. Vierra, highway maintenance man III, 36 years; Ernest P. Hay, associate highway engineer, 35 years; Clarence C. Knee, janitor, 11 years.

District IV

Alice R. Beard, intermediate account clerk, 13 years; William T. Byroads *, highway maintenance man II, 31 years; Leo E. Murray, highway foreman, 29 years; Leo Rinne, assistant highway engineer, 7 years; Albert J. Rogers, highway maintenance man II, 4 years; Anton M. Kiser, highway foreman, 37 years; Oleg V. Prasalov, assistant highway engineer, 11 years; Florence Shaughnessy *, intermediate stenographer, 11 years; Arthur B. Burger, highway maintenance man II, 34 years; Julius Hyland, highway maintenance man II, 28 years.

District V

Russell H. Massengale, janitor foreman I, 28 years; James R. Jensen, highway foreman, 32 years; Claude H. Hixson, highway superintendent, 29 years; Paul A. Beyer, junior civil engineer, 6 years; John E. Maryfield, groundsman, 4 years.

District VII

Dewey C. Aderson, highway foreman, 38 years; Emmett Bush, laborer, 36 years; Fern B. Fleharty, senior accountant clerk, 5 years; Ellsworth R. Talmon, associate highway engineer, 29 years; Earl H. McBroom, senior highway engineer, 33 years; Bertha A. Newton, delineator, 12 years; John H. Powell, groundsman, 6 years; Frank B. Cressy, supervising highway engineer, 36 years.

District VIII

Thomas G. Duff, associate highway engineer, 11 years; Harold Lienav, highway foreman, 28 years; Josephine G. Park, reproduction machine operator, 10 years; Henry E. Maynard, highway foreman, 33 years; Ralph Setser, highway maintenance man II, 28 years; Glenn E. Bridgman, senior clerk, 13 years.

District IX

Burton F. Moore, assistant highway engineer, 33 years; H. Earl Wise, assistant highway engineer, 8 years; Thomas Buckley, highway maintenance man I, 18 years.

District X

Henry J. Cox, senior highway foreman, 33 years; Gage Treganza, highway maintenance man II, 30 years.

District XI

Henry Box, highway maintenance man II, 27 years; Dick Elder, highway foreman, 31 years; Vernon J. Decker, highway foreman, 31 years.

* Disability.

Buellton Road Super C. H. Hixson Retires

Claude H. Hixson, highway superintendent, retired February 15, 1963, after more than 29 years of service with the State of California. Hixson began his service in September 1933 as a highway road laborer. He was promoted to highway maintenance leadingman in January 1940 and to highway maintenance foreman in July 1942. He was promoted to his present position of highway superintendent in April 1950. Hixson worked in District III from September 1933 until April 1950 when he was promoted and transferred to District V. He has worked out of the Cambria and Buellton maintenance stations while in District V.



CLAUDE H. HIXSON

Hixson enjoys hunting and fishing as hobbies. He and his wife "Gussie" are presently traveling, a pastime they will engage in more extensively after his retirement.

DAY USE FOR GEODIMETER

A special converter device is now being installed on all its geodimeters by the Division of Highways making possible the daytime use of these instruments. (See "Meet The Geodimeter," *California Highways and Public Works*, May-June 1962).

Daytime operation will not only result in substantial money savings but will eliminate hazards connected with nighttime use of the equipment.

State-owned Toll Bridges

Ambrose W. Koziol, structural steel painter, 15 years; Harry E. Schaumburg, structural steel painter, 10 years; Genevieve E. Rohl, supervising clerk I, 35 years.

Shops

Cleone M. Meachem, intermediate typist clerk, 29 years; Harry I. Overstreet, heavy equipment mechanic, 20 years; John C. Bening, automobile mechanic, 39 years.

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

HIGHWAY TRANSPORTATION AGENCY

ROBERT B. BRADFORD . . . Administrator

DEPARTMENT OF PUBLIC WORKS . . . JOHN ERRECA, Director

FRANK A. CHAMBERS . . . . Chief Deputy Director

RUSSELL J. COONEY . . Deputy Director (Management)
HARRY D. FREEMAN . . Deputy Director (Planning)

T. F. BAGSHAW . . . . . Assistant Director
JOHN H. STANFORD . . . . . Assistant Director

JUSTIN DuCRAY . Departmental Management Analyst
S. ALAN WHITE . . Departmental Personnel Officer

DIVISION OF HIGHWAYS

J. C. WOMACK . . . State Highway Engineer, Chief of Division

CHAS. E. WAITE . . . Deputy State Highway Engineer
J. P. MURPHY . . . Deputy State Highway Engineer
J. A. LEGARRA . . Deputy State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
GEO. LANGSNER . . Assistant State Highway Engineer
FRANK E. BAXTER . Assistant State Highway Engineer
J. C. BURRILL . . . . . Comptroller
JOHN L. BEATON . . . . . Equipment Engineer
C. G. BEER . . . . . Urban Planner
L. L. FUNK . . . . . Planning Engineer
GEORGE A. HILL . . . . . Traffic Engineer
F. N. HVEEM . . . Materials and Research Engineer
J. F. JORGENSEN . . . . . Construction Engineer
SCOTT H. LATHROP . Personnel and Public Information
C. T. LEDDEN . . City and County Projects Engineer
H. C. McCARTY . . . . . Office Engineer
E. J. L. PETERSON . . Program and Budget Engineer
R. V. POTTER . . . . Systems Research Engineer
E. L. TINNEY . . . . . Maintenance Engineer
W. L. WARREN . . . . . Engineer of Design
G. M. WEBB . . . Traffic Engineer—Special Studies
A. L. ELLIOTT . . . . Bridge Engineer—Planning
L. C. HOLLISTER . Bridge Engineer—Special Projects
I. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area

Right-of-Way

RUDOLF HESS . . . . . Chief Right-of-Way Agent
DEXTER D. MacBRIDE . . . . . Assistant Chief
RAY E. O'BIER . . . . . Assistant Chief
R. S. J. PIANEZZI . . . . . Assistant Chief
JACQUES T. ZEEMAN . . . . . Assistant Chief

District I, Eureka

SAM HELWER . . . . . District Engineer

District II, Redding

H. S. MILES . . . . . District Engineer

District III, Marysville

ALAN S. HART . . Assistant State Highway Engineer

District IV, San Francisco

J. P. SINCLAIR . . Assistant State Highway Engineer
R. A. HAYLER . . . . . District Engineer
HAIG AYANIAN . . . . . District Engineer
C. F. GREENE . . . . . District Engineer

District V, San Luis Obispo

E. R. FOLEY . . . . . District Engineer

District VI, Fresno

W. L. WELCH . . . . . District Engineer

District VII, Los Angeles

E. T. TELFORD . . . Metropolitan District Engineer
A. L. HIMELHOCH . . . . . District Engineer
A. C. BIRNIE . . . . . District Engineer
A. W. HOY . . . . . District Engineer
R. E. DEFFEBACH . . . . . District Engineer

District VIII, San Bernardino

C. V. KANE . . . . . District Engineer

District IX, Bishop

C. A. SHERVINGTON . . . . . District Engineer

District X, Stockton

JOHN G. MEYER . . . . . District Engineer

District XI, San Diego

JACOB DEKEMA . . Assistant State Highway Engineer

State-owned Toll Bridges

CHARLES L. SWEET . . . . . Bridge Engineer

CALIFORNIA HIGHWAY COMMISSION

JOHN ERRECA . . . . Chairman and Director of Public Works
JAMES A. GUTHRIE . . Vice Chairman San Bernardino
ARTHUR T. LUDDY . . . Sacramento
ROGER S. WOOLLEY . . . San Diego
ABRAHAM KOFMAN . . . San Jose
FRANKLIN S. PAYNE . . Los Angeles
JACK COOPER, Secretary . . . Sacramento

DIVISION OF CONTRACTS AND RIGHTS-OF-WAY (LEGAL)

ROBERT E. REED . . . . . Chief Counsel

GEORGE C. HADLEY . . . . . Assistant Chief
HOLLOWAY JONES . . . . . Assistant Chief
HARRY S. FENTON . . . . . Assistant Chie

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

NORMAN C. RAAB . . . . Chief of Division
BEN BALALA . . . . . Principal Bridge Engineer

DIVISION OF ARCHITECTURE

EARL W. HAMPTON . . . Acting State Architect, Chief of Division

EARL W. HAMPTON . . . . . Deputy Chief, Architecture and Engineering
HUBERT S. HUNTER . . . . . Deputy Chief, Administrative
ARTHUR F. DUDMAN . . . . . Assistant State Architect (North
TOM MERET . . . . . Assistant State Architect (South
CHARLES M. HERD . . . . . Chief Construction Engineer

DIVISION OF AERONAUTICS

CLYDE P. BARNETT . . . . . Director, Chief of Division

83448 3-63 52,800

printed in CALIFORNIA STATE PRINTING OFFIC

EDMUND G BROWN

State of California

GOVERNOR'S OFFICE

SACRAMENTO

California is happy to join with our sister states and the Federal Government in the third annual observance of National Highway Week, May 26-June 1, 1963.

Nearly every week is a "highway week" in some part of California as we extend by some 200 miles a year our network of modern freeways. Last year we opened more than 50 miles of major freeways in the Los Angeles metropolitan area alone.

This accomplishment is the end result of sound long-range planning, cooperative State-local teamwork, skilled engineering, and efficient construction methods. It adds up to greater ease and safety for the movement of our people and our products--amounting to the staggering total of more than 70 billion vehicle-miles per year.

This year, in addition to pausing to take note of our continuing highway progress, I hope the people of California will make National Highway Week a week of especially safe driving. Our freeways save more than 300 lives a year, but we are still killing and maiming too many of our people in needless traffic accidents.

Let us make our driving worthy of our highways.

Edmund G. Brown

EDMUND G. BROWN, Governor

nia Highways and Public Works
ISION OF HIGHWAYS
P O BOX 1499
AMENTO, CALIFORNIA

ETURN REQUESTED

SEATTLE PUBLIC LIBRARY
4TH & MADISON
SEATTLE 4, WASHINGTON

R56

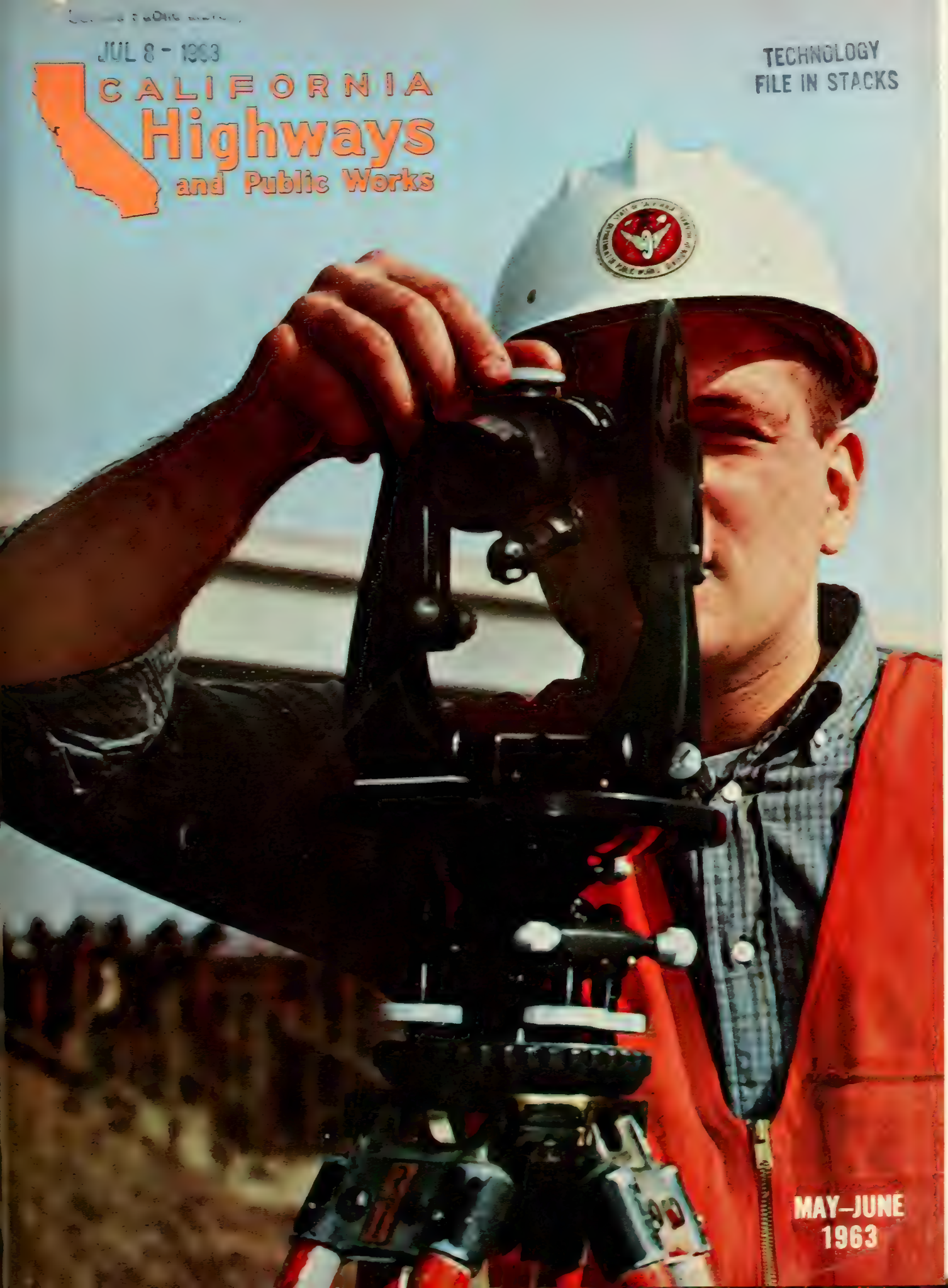
BULK RATE
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152



JUL 8 - 1963

CALIFORNIA Highways and Public Works

TECHNOLOGY
FILE IN STACKS



MAY–JUNE
1963



Aerial view of site.



DEVIL'S CANYON BRIDGE

A critical stage in the construction of a bridge in Devil's Canyon in the barren Jacumba Mountains east of San Diego is shown in the photographs here and inside the back cover. The problem was handling steel girders up to 167 feet long and nearly 10 feet deep, weighing 43 tons, in rock-bound country as barren as the surface of the moon.

This bridge is one of two of the same type close together on this 10-mile section of U.S. 80/Interstate 8 being constructed on new alignment to carry the two westbound lanes of the route in the vicinity of the San Diego-Imperial county line. Travelers are undisturbed by the construction, since traffic continues to use the old route through In-Ko-Pah Gorge. When the Devil's Canyon section is completed, all traffic will be switched to it temporarily during modernization next year of the old route. The final result, of course, will be separated routes for eastbound and westbound traffic, constructed to Interstate standards.

Because of the difficulty of moving heavy equipment over the rugged terrain, it would have been extremely difficult to bring in cranes heavy enough to handle the girders. The rather unique solution of a "high line"

(Continued on inside back cover)

Above and Below: High line operation moving girders.



California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

Vol. 42 May-June Nos. 5-6



FRONT COVER: Steve Macala, Assistant Highway Engineer, Drainage Department, District VII Headquarters, Los Angeles, posed for the front cover to illustrate the professional rotation program for young engineers. See story "Job Rotation" on page 2. (Photo by Robert Dunn.)

BACK COVER: Illustrating one of the highways of District IV is the freeway between Walnut Creek and Lafayette, photographed at the Pleasant Hill interchange. See "Bay Area Report" on page 25. Photo by Jack Meyerpeter.)



CONTENTS

	Page
Job Rotation By A. C. Birnie, District Engineer—Administration	2
William Whitehurst Named to Commission	6
Career Guidance	7
U.S. 40 in Solano County	8
Stockton Model By Thomas T. White, Senior Delineator	12
Reflective Markers By Herbert A. Rooney, Senior Chemical Testing Engineer	13
Sacramento River Canyon By Ellis C. Engle, District Construction Engineer	17
Canyon Route History By Mark E. Cessna, Associate Highway Engineer	17
Bay Area Report—1963 By J. P. Sinclair, Assistant State Highway Engineer	25
Annual District Right-of-way Agents Meeting	50
New Striper By R. C. Grout, Assistant Equipment Engineer	51
Seismic Tests—2 By Dewey W. Knittel, Associate Engineering Geologist, and Marvin L. McCauley, Assistant Engineering Geologist	54
Governor Appoints New State Architect	58
Wrong-way Drivers	59
Merit Awards	61
Commission Adopts Freeway, Highway Routings	63

Retirements

Wayne M. Blotter	58	W. L. McFadden	60
Henri Campagnon	58	C. C. Winter	11
Patrick Devine	58		

Obituaries

K. A. MacLachlan	62	Robert E. Reed	63

LESTER S. KORITZ, *Editor*

STEWART MITCHELL, *Associate Editor* JOHN C. ROBINSON, *Associate Editor*

WILLIAM R. CHANEY, *Chief Photographer*

Editors are invited to use information contained herein and to request prints of any black and white photographs.

Address communications to: EDITOR,

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

P. O. Box 1499

SACRAMENTO, CALIFORNIA

Job Rotation

Broad, Varied Program Offered New Engineers

By A. C. BIRNIE, District Engineer—Administration, District VII

The highway builder of bygone days could lay out routes by following cowpaths, Indian trails, or the general lay of the land. His problems were uncharted country, untamed rivers, climate and geography that his primitive science struggled to cope with. The traffic he served was a sparse caravan of farm wagons and tin lizzies, which moved only in dry weather, and slowly even then.

Contrast his task with that of today's freeway builder, who must tackle huge traffic loads and skyrocketing land prices, who must design high-speed multilane all-weather interchanges, who must alter the terrain as often as he follows it.

For the young engineer going into highway work now, today's training is specialized, and tomorrow's training may be automated. Is today's young highway builder doomed to a pigeonhole phase of the operation, with basic decisions eventually delegated to a computing machine?

A Unique Program

To free the young engineer of the claustrophobia caused by narrow specialization—and to provide the public with highway leadership for the future—the California Division of Highways in 1957 instituted a unique program for junior civil engineers, the beginning level for graduate engineers.

EDITOR'S NOTE

Although this article describes the rotation procedure for junior civil engineers in one district, the program is uniform throughout all 11 highway districts in the State.

The order by the State Highway Engineer establishing the rotation program, dated June 3, 1957, allows the employing unit discretion as to the order in which the rotation assignments may be made in each case, but the program itself is compulsory.



Arriving at work, the new junior civil, illustrated by Steve Macola, gets his employment information packet from Mary Hanson, personnel clerk.

Upon going to work for the division, each "junior civil" is placed in a rotation program which includes: six months in design, eight months in construction, four months in surveys (preliminary and construction stakeout), and a final six-month period in a fourth phase of highway work. A report is made on his performance in each phase, indicating assignments completed, employee's progress, and future schedule. He gets a copy of each report as does headquarters office in Sacramento.

At the end of this two-year program, he can expect to look back on two principal accomplishments: (1) he has demonstrated what specialty he can do best; (2) he has gained some first-hand familiarity with the scope of highway work.

With this foundation, he then steps into his first permanent assignment. A certain amount of rotation will continue throughout his work with the division, too, so that he can advance logically to positions of wider responsibility.

The same policy of rotation – for constantly broadening experience – applies to the so-called technician categories within the division. Many opportunities exist in the jobs of engineering aid and promotional levels above them, constituting a parallel series of positions leading to highway engineering associate, with the possibility of "crossing over" to professional category along the way. In this manner, a qualified man is trained for important work even though he may lack a college degree.

Two-year Rotation

The two-year rotation program, however, is specifically geared to junior civil engineers. Gaining Cali-

ornia a nationwide reputation among spiring civil engineering students, this rogram attracts many a top graduate o enter state employment.

Prepared by printed information rom the State Personnel Board, the pplicant first meets one of the re-ruiters—generally a young engineer who faced the applicant's own prob-ems only a few years ago. In his half-nour meeting with each applicant, the ecruiter interviews the student on his ollege career and professional inter-sts and helps him fill out the neces-sary forms. He also informs each stu-dent of the kinds and location of work, the rotation system and other facets of the California program such as leadership in technical fields, a civil service structure free from political pressure and funds devoted exclusively to highway purposes.

About 40 percent of student appli-cants contacted select highways. The student is invited to express a prefer-ence for the locale or highway dis-trict where he would like to work, and a firm job offer is made.

Once recommended, the applicant receives confirmation of the offer of work from Division of Highways Headquarters in Sacramento. In the case of District VII, this is followed up by a letter from the district per-sonnel officer, Lloyd B. Hughes, en-closing printed information on the Los Angeles area in general and on high-way and freeway progress in the dis-trict. The young engineer, on accept-ing employment, indicates his choice of the first assignment on his rotation program, and insofar as possible, he is accommodated.



In design, Steve transfers necessary information to an interchange drawing, for the use of the bridge department. In background, Tony Wong.



On construct on, Steve acts as the resident engineer's representative on one phase of the job. Here he confers with Clarke Tape, contractor's paving superintendent during construction on the San Diego Freeway.

Career Goals Discussed

Arriving at work, individually or in a group, the new junior civil meets an executive of the district, to discuss immediate problems and future plans. This conversation covers subjects ranging from career goals to housing accommodations. The top level of the district is deeply concerned with each new man, his welfare and his value.

Next, the junior civil reports to per-sonnel and maps out his first three assignments, thus getting a preview of his work experience for the next year and a half, depending on district re-quirements. Decision is deferred on the final stage of rotation, until the new man becomes more familiar with assignments which may be available.

Now he goes to work, reporting either to design, construction or sur-



Working with the materials section along the route of a future freeway. Steve removes a soil sample from the drill rig. Assisting is Dick Hubinger, engineering aid.

veys. At the end of each phase, he returns to the personnel office for a conference.

Merle D. Demroff, assistant personnel analyst, maintains direct contact with the junior civils throughout the district. At each interview, he asks them questions like, "How successful was this phase?" . . . "What did you do; were you given responsible tasks?" . . . "How was the supervision; do you have any suggestions for improvement?"

If there is widespread criticism of any one phase of the program, the problems are brought to the attention of the section involved. In this manner, the junior civil is afforded the opportunity to evaluate his own experience, while being evaluated himself.

Rotation Sequence Changed

Occasionally, rotation sequence is changed to accommodate work requirements of the district—or to accommodate the junior civil himself. Example: the young husband who asked to be assigned inside the building for a while so he could be near a phone. He's now a proud new father.

"The underlying factor to remember," says Demroff, "is that this is a management trainee program of a unique nature." As a recent rotatee put it, "Where else do you get a 20-to-30-million-dollar set of plans to turn out? I feel that we're really doing big work." To which Demroff adds: "What other firm will risk $15,000 to train a new man for two years?"

What is a typical rotatee's experience?

Steve Macola first learned of the program while an undergraduate in Connecticut. He selected California as the place he wanted to build highways, and a major reason for his choice was the practical appeal of rotation. Eager for breadth of experience, Steve worked with materials testing, as well as construction, design, and surveys, and then got his permanent assignment in still another department—drainage, where he is now an assistant highway engineer.

New Features Added

New features have been added to the rotation program since Steve completed his two-year stint. One example of improved service is the photogrammetric on-the-job training program now included in the survey phase of rotation. The program consists of a minimum of 40 hours and includes:

A. Basic Principles of Photogrammetry
   1. Aerial photography
   2. Aerial mosaics
   3. Planimetric maps
   4. Topographic maps
   5. Ground control
   6. Stereoplotting instruments

B. Photogrammetry for Highway Engineers
   1. Mosaics
   2. Reconnaissance type maps
   3. Design type maps
   4. Testing maps
      a. General Specifications
      b. Special provisions
      c. Office checks
      d. Field checks

C. Contracts
   a. Competitive bid
   b. Plotter rental

D. Type of Training
   a. Lecture (photogrammetry and photogrammetric products as procured and applied in district; also types and kinds).



Now an assistant highway engineer in the drainage department, Steve checks a culvert in Ventura County: the Harman Barranca channel, designed to carry 2,200 cubic feet per second.

b. Self-study (A.S.P. Photogrammetry Manual, U.S.C. & G.S. Photogrammetry Manual, Headquarters and District Photogrammetry Manual).

c. Practical (office editing and checking maps, mosaics, contact prints; plotting flight lines, developing supporting maps and data; indexing and filing).

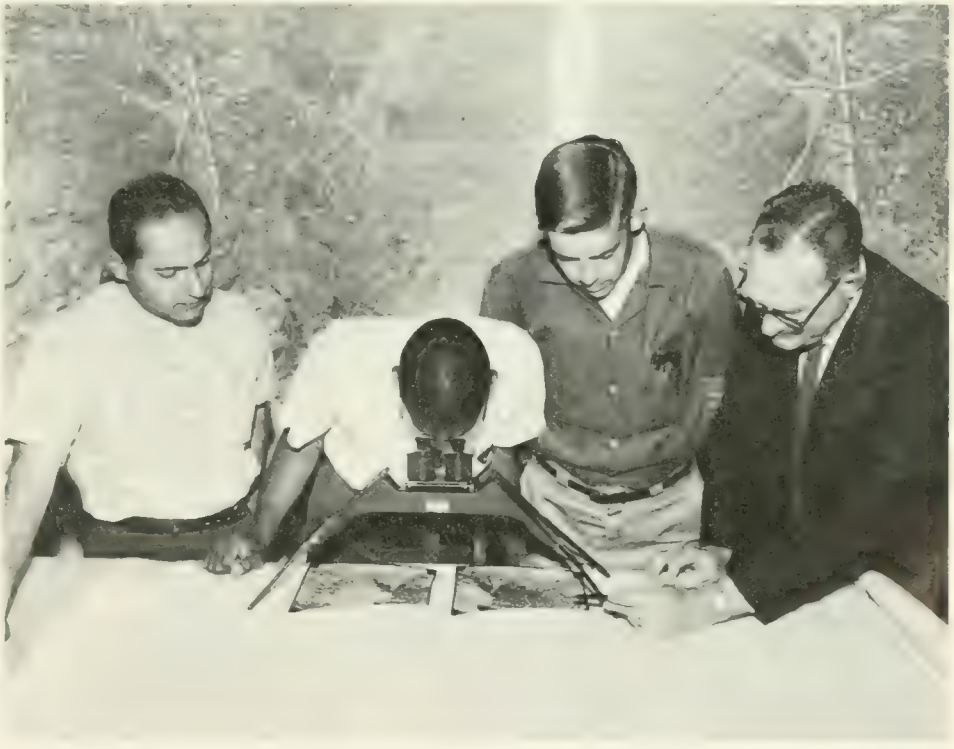
The purpose of the photogrammetry training is to acquaint new junior civils going into other departments with the service available to them through the medium of aerial photography and mapping. This is in addition to the traditional survey skills covered in his four-month phase: three of those months on a construction job where he is given an opportunity to do all types of jobs; and brief courses in field first aid and safety, lane closure signing, and training and licensing in the Ramset—a device which shoots a cartridge into concrete to use as a horizontal control in surveying. A. K. Goldin, district surveys engineer for construction, is enthusiastic about giving the beginning engineer a thorough grounding in the most modern methods.

"Although they usually go to permanent assignments in other departments, we want them to know what we can supply to them—especially in this aerial work. With one of these aerial contour maps, one operator can get the information in one day that would otherwise take a survey party several weeks."

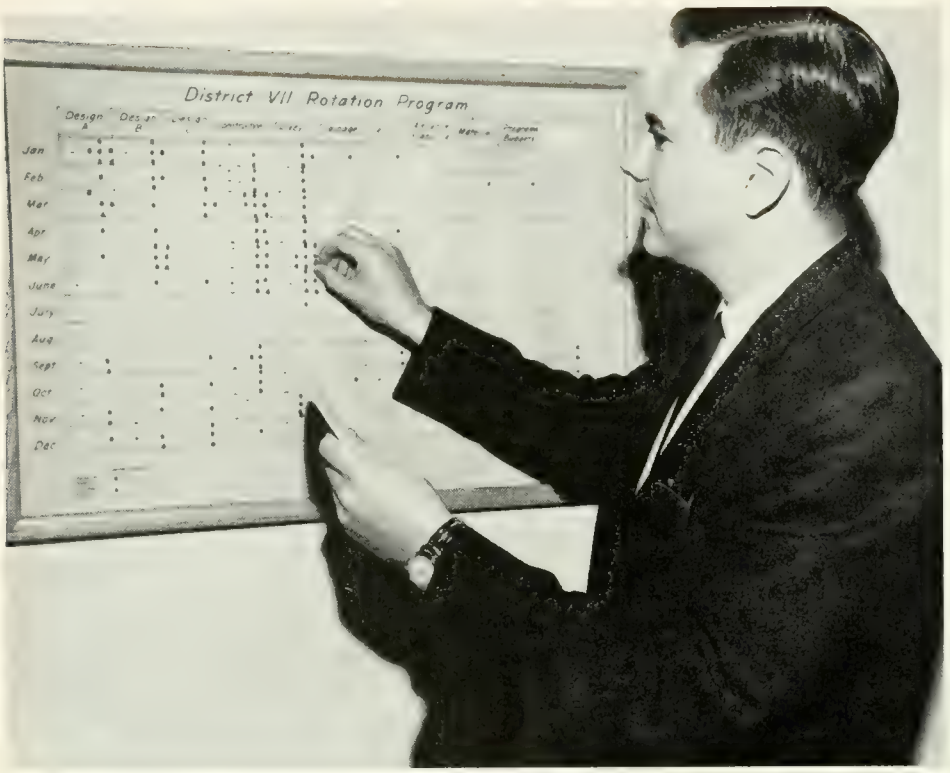
Military Leave

Military leave is an important factor among rotatees, both in bridge and general highways work. California's provisions for military training leave apply to any employee in good standing—either probationary or permanent—with full reinstatement of salary and seniority status upon return to work. If the junior civil can complete a full year of work before going into the armed forces, he is eligible to draw state pay during his first 30 days of military service.

Starting salary is, of course, an important factor to a young man even in his first professional employment. Recruiters like Richard Williams of District VII's design section, operating in southern states where lower wage rates prevail, found the applicants impressed – and pleasantly sur-



T. C. Spencer, right, supervisor of the photogrammetry section, explains use of the stereopticon viewer for aerial prints, to junior civils Ed Kashfi, Oliver Maxie, (at viewer), and Norman Taylor.



Merle D. Demroff, assistant personnel analyst, keeps rotatees' assignments in line with work demands. District VII has 115-120 junior civil engineers going through its rotation program constantly.

prised—with the monetary value California puts on its young engineers.

Not all junior civils come to the division via the college recruiter. John Sheehan, in the Los Angeles office of the State Personnel Board, certifies many young men, previously uncontacted, who become highway engineers in District VII.

In Sixth Year

Now in its sixth year, how is the rotation program working?

Charles Bartell, of District VII's route planning section, knows the program firsthand—as a former junior civil, as a sometime recruiter in western states, and as a present senior highway engineer supervising the training of several junior civils in his own section.

"I was a good recruiter," says Bartell, "because I'm completely sold on the program myself. I could honestly tell the fellows what it's meant to me, and what the division has to offer. When I first came to work here, I thought of it as a 'first job'—some place to get five years' experience and then go out and find something better. But I've been with the State seven years now and have no thought of leaving. This is challenging and important work. If a fellow has any doubt of that, two years of rotation will convince him."

It will also do something more for him, something at least as practical, for the experience accomplished in these two years is applicable to requirements for registration. In addition, a large majority of men who have successfully completed their rotation program in District VII have at the same time achieved promotion to assistant highway engineer.

Currently, District VII's typical distribution of rotatees finds:

30 in construction	10 in traffic
30 in design	5 in materials
20 in surveys	10 in route planning
10 in drainage	1 in advanced planning

Swelling population and mounting traffic demands add up to a challenging future for the highway engineer in Southern California. In 1980, the State will have twice the vehicles it has now. But by 1980, fully four times today's freeway mileage will be built to help carry that double load.

William Whitehurst Named to Commission

William S. Whitehurst of Fresno was appointed to the California Highway Commission in April by Governor Edmund G. Brown, filling the vacancy created earlier in April by the Governor's appointment of John Erreca of Los Banos as State Director of Public Works and ex officio chairman of the commission.



WILLIAM S. WHITEHURST

Whitehurst's appointment is for the balance of Erreca's four-year term as a commission member, which expires January 15, 1965.

The new commissioner is a licensed mortician and has interests in four funeral chapels in the Fresno-Merced County area. He is also active in real estate and ranching.

City Councilman

Whitehurst's earliest governmental activity was as a city councilman in Los Banos in 1943. He served with the Army's 1st Cavalry Division in the Pacific in World War II, and later made his home in Dos Palos, where he was a city councilman from 1949 to 1953. He is a graduate of St. Mary's College.

Career Guidance

Exhibits Spur Student Interest in Engineering



Some 43,000 students from high schools and junior high schools throughout the Los Angeles area visited the Career Guidance Center, sponsored by the Los Angeles County Schools at the Great Western Exhibit Grounds, March 6-15. The Division of Highways booth attracted particular interest from the older students, and an estimated 30,000 pieces of literature were distributed.

Manning the booth, in rotating teams, were Lloyd Hughes, Merle Demroff, and Mark Johnson of personnel, and Bob Innes and John Muhich, construction. One engineer and one personnel officer worked together throughout the exhibit hours.

Narrated Slide Show

Flanked by the Marine Corps and sheriff's department, the highways exhibit featured a narrated slide show, a scale model of the Pomona-Long Beach Interchange, and a transit through which the students enjoyed sighting in on a target at the opposite side of the booth.

Planned as long-range guidance for youngsters interested in a civil engineering career, the exhibit also yielded an unexpected immediate return. A senior in engineering at a local state college made his first contact with the Division of Highways at the exhibit, and as a result will go to work here in the summer as a junior civil engineer.

Other Exhibits

The University Club, at Sixth and Hope Streets, was the scene of a Division of Highways exhibit from March 18 to 25. Entitled "California Freeway System," the exhibit featured maps, charts, and photographs, illustrating the purpose and function of the freeway network, along with the scale model of the future Pomona-Long Beach Interchange.

Highway Goals

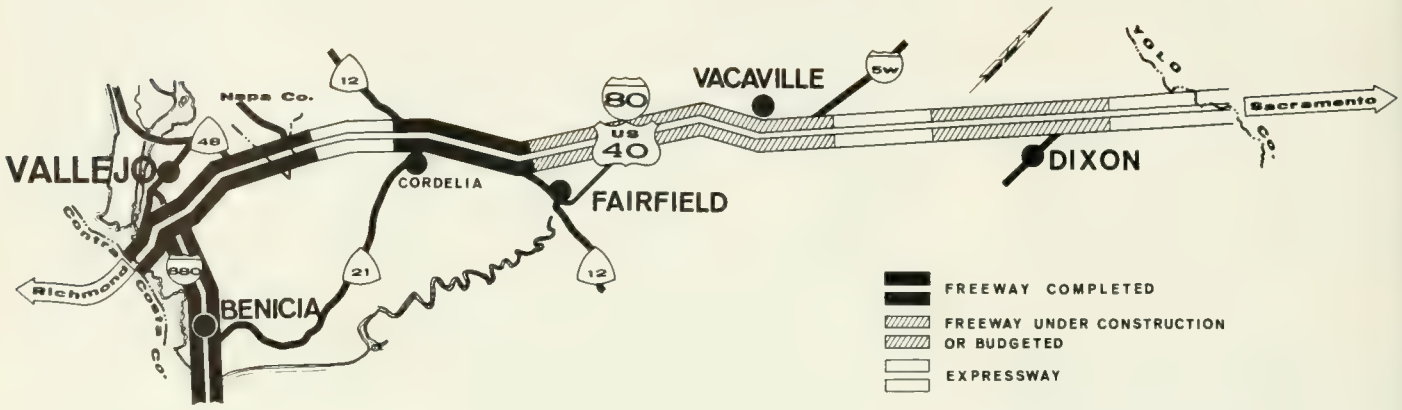
"California Highway Goals" is the theme of the new 24-foot-long exhibit mounted on the wall of the surveys corridor, on the first floor of the new building. Prepared at the request of Assistant District Engineer A. D. Mayfield, this display contrasts present achievements and conditions with those we can look forward to in 1980.

Freeway Model

On April 1 through 8, the Santa Monica-San Diego Freeway Interchange model built by John and Peggy Unruh was displayed at the Wilshire National Bank, Westwood. Flanking the model were before-and-after photos of the "Big Cut."



Look, kids, a new freeway! High school students get maps from Merle Demroff, at left, while John Muhich shows others how to sight through a transit, during career guidance exhibit.



Map shows freeway progress on U.S. 40/Interstate 80 in District X sector—between Carquinez Strait and Yolo county line.

U.S. 40 in Solano County

By J. G. MEYER, District Engineer



District X continues to maintain its schedule in converting U.S. 40 (Interstate 80) in Solano County from expressway standards to full freeway status prior to the 1972 target date. Since the last report (in the September-October 1961 issue of *California Highways and Public Works*) three contracts have been awarded for the construction of approximately 13 miles of freeway at a total cost of $8,600,000 bringing the total of freeway completed or under construction to 55 percent of the route located in District X.

Plans for the conversion to freeway standards of the remaining 20 miles of this route are virtually complete. Seven miles are budgeted for the 1963-64 construction year and the remainder will go to construction as soon as financing can be arranged. A graphic portrayal showing the status of the various sections of this important interstate route is revealed on the map on this page. It is noted that there are only three sections of expressway which remain to be budgeted and converted to full freeway.

American Canyon Project

Traffic is now using that portion of U.S. 40, reconstruction of which was awarded to the Wunderlich Company on February 16, 1961. The original plan calling for the construction of four miles of six- and eight-lane divided freeway was enlarged to provide a full eight-lane divided freeway from near the Vallejo city limits easterly across Hunter and Rindler Hills and the upper portion of the American Canyon.

This project provides a grade separation structure at U.S. 40 and State Sign Route 48 and an overcrossing at the intersection of U.S. 40 with the American Canyon Road together with necessary on and off ramps. The American Canyon Road intersection was moved about 3,000 feet easterly necessitating the construction of about one mile of county road.

In order to make the most efficient use of this new construction, Napa and Solano Counties have joined forces and awarded a contract to reconstruct the balance of the American Canyon Road to federal aid secondary standards. The portion being so reconstructed is from the end of our reconstructed section to State Sign Route 29.

As noted in the September-October 1961 issue, water in damaging quantities was encountered in all cuts and most of the fill areas. The cost of subdrainage correction work was nearly double the original estimate. As construction progressed and the big cut through Hunter Hill exposed more of the underlying material, it became apparent that the material was too unstable to support itself on the designed slopes and as the cut became deeper excessive amounts of water were encountered which further weakened the stability of the material.

Not only was it necessary to flatten the slopes from planned $2\frac{1}{2}$:1 to $3\frac{1}{2}$:1, it was also necessary to install horizontal drains. These were placed in both slopes of the cut and most of them are still flowing. The total cost of this project was $5,500,000, some $750,000 over the original estimate. R. B. Weaver was resident engineer for the State.

Cordelia Project

The construction of 4.4 miles of six and eight lanes of divided freeway with six bridges, three overcrossings, one separation structure at the intersection of U.S. 40 and State Sign Route 21 and an overhead structure at Cordelia over the Southern Pacific railroad was awarded to Gordon H. Ball on April 4, 1960, and completed on December 28, 1961. Completion of this project, with F. M. Babcock representing the State as resident engineer, extended the freeway section from the easterly end of the American Canyon to the Fairfield turnoff.

Fairfield Interchange

In connection with the construction of the interchange structure proper 1.6 miles of six lanes of divided freeway were also constructed which continued the freeway system easterly from the above project. This project was awarded to Charles L. Harney Company, Inc., on June 27, 1960, and completed on December 15, 1961.

This project provided a separation structure carrying U.S. 40 over State Sign Route 12 and the adjacent Sacramento Northern railroad tracks. This project had long been anticipated by the traveling public because it eliminated the last highway traffic signal between San Francisco and Sacramento. Final cost of this project was $1,830,000. George Demetras was the State's resident engineer.

Travis Boulevard Project

This project continues the six-lane divided freeway system 1.2 miles easterly of the above project and provides an overcrossing for Travis Boulevard along with the necessary on and off ramps. The six-lane construction consists of adding another PCC lane along the outside of the existing 24-foot slabs.



Aerial view of new Rindler fill and Hunter Hill cut looking westerly toward Vallejo. Oval in distance is racetrack on Solano County Fairgrounds.

This project was awarded to Ball and Vickery, Inc., and John W. Vickery, Jr., on November 9, 1961, and was completed in February 1963 at a cost of $490,000. Dudley Hatch was the State's resident engineer.

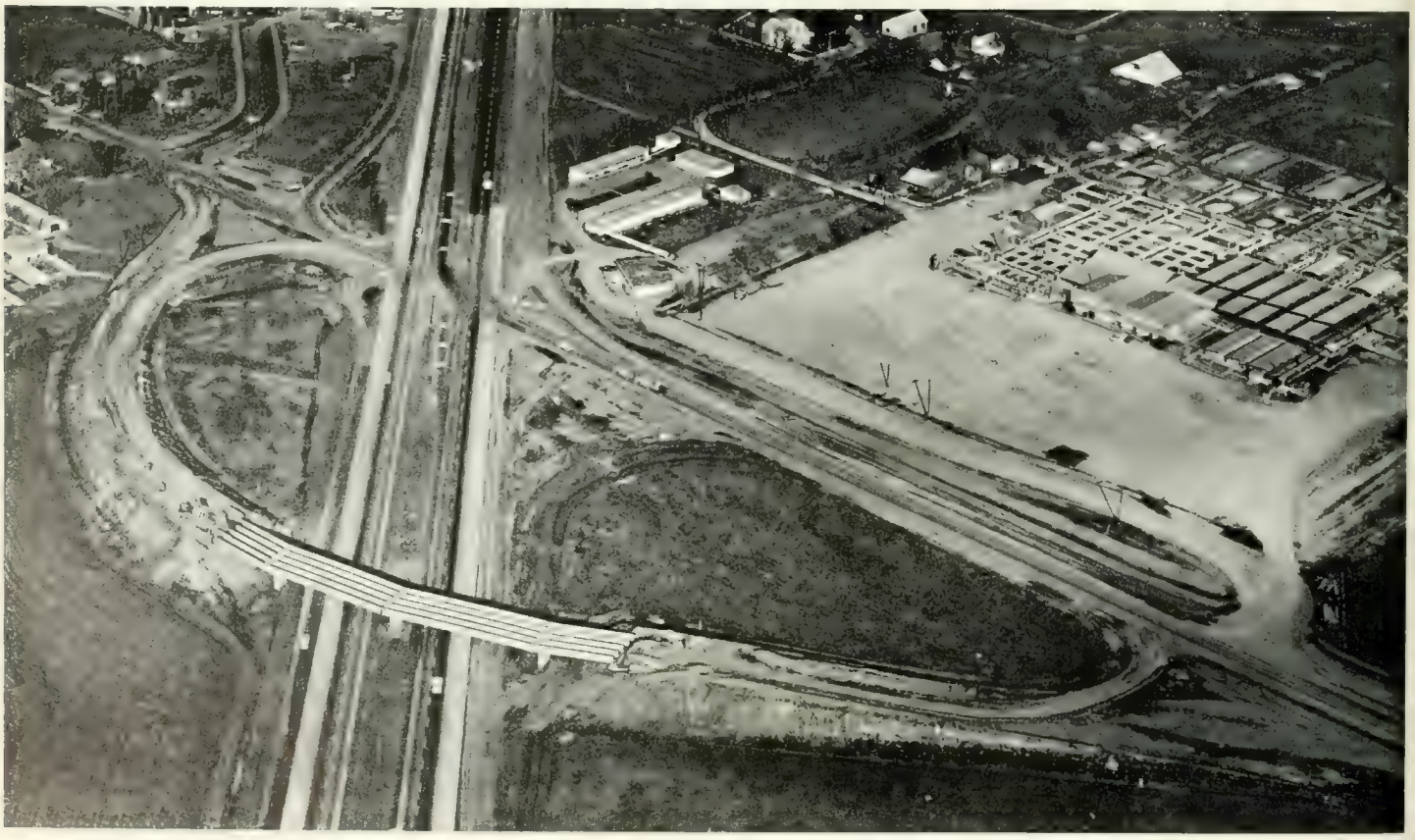


Looking westerly toward Travis Boulevard overcrossing near Fairfield.

Vacaville Project

A contract was awarded to Gordon H. Ball and Gordon H. Ball, Inc., on November 17, 1961, to construct 5.1 miles of six-lane divided freeway through the City of Vacaville ending nearly one mile east of the Route 90 (Interstate 5W) Intersection. Herman Jantzen is the State's resident engineer on this project.

To convert this expressway to freeway standards, one new PCC lane is being added to the existing 24-foot PCC slab on a short section and the balance of the project will consist of all new 36-foot PCC pavement. This project also calls for widening nine bridges, constructing five new bridges,



Interchange at U.S. 40 and Legislative Route 101 at the Milk Farm (top left) looking easterly along U.S. 40 toward Sacramento, Dixon to right.



Looking westerly along U.S. 40 at Pitt School road overcrossing.

constructing two overhead structures, which will carry U.S. 40 over Davis Street and the Sacramento Northern railroad tracks and four overcrossings together with the necessary on and off ramps and frontage roads. It is anticipated that the cost will be $5,750,000.

It is anticipated that this project will be completed in the spring of 1964.

Dixon Project

A contract was awarded to Frederickson and Watson Construction Company on January 25, 1962, to construct seven miles of six-lane divided freeway from Midway Road to Pedrick Road. Pedrick Road is located about one mile east of the junction of U.S. 40 and State Route 101 leading to Dixon. This project consists of adding an additional PCC lane on the outside of the existing eastbound and westbound PCC lanes for about six miles of the project length. The remaining mile consists of placing a cement-treated base widening strip 13-feet wide on the outside of the existing pavement and capping the full 36 feet with AC paving.

Reconstruction of this portion will necessitate the widening of four bridges and an equipment and cattle pass and the construction of one new bridge, two overcrossing structures, one separation structure at the intersection of U.S. 40 and State Route 101 and approximately two miles of frontage roads with the necessary on and off ramps at the various structures.

This project lies in the newly created Solano Irrigation District, which began active service about two years ago. Construction of this project was hampered by the fact that new irrigation in the surrounding area had raised the water table to the point that it had saturated the basement soil of the entire project. To correct this condition, it was necessary to remove the saturated material and reconstruct the entire section.

Merle Larrabee is the resident engineer. He estimates that this project will be completed by June of 1963.

One of the main feeder roads to U.S. 40 is Interstate 680 which was completed to four-lane divided freeway standards on September 15, 1962. This project connects the new Benecia-Martinez Bridge to U.S. 40 and Vallejo. Northbound traffic can also use the old two-lane road to Cordelia. This portion of two-lane road is the original pavement laid in 1914 as part of the then Route 7.

Supervising Engineer C. C. Winter Leaves

C. C. "Buck" Winter, supervising bridge engineer with the California Division of Highways, has retired after 31 years in state service.

Winter has been in charge of all bridge construction activity on the state highway system in Northern California Since 1950.



C. C. WINTER

A native of La Crosse, Wisconsin, Winter graduated from the University of Cincinnati with a degree in civil engineering.

He joined the division as a junior bridge engineer in 1931.

From 1933 to 1937 he was assigned to the staff which supervised construction of the San Francisco-Oakland Bay Bridge. He was promoted to supervising bridge engineer in 1950.

He served three and a half years with the Navy Seabees during World War II, retiring with the rank of commander.

Winter and his wife, Rosella, have a son and a daughter.

Winter is a member of the American Society of Civil Engineers. He is also a Mason and a member of the Elks.

NEW LEGISLATION SIMPLIFIES HIGHWAY NUMBERING

Senate Bill 64, providing for renumbering of the state highway system to eliminate the long-standing multiplicity of various route designations for legal, administrative and traffic purposes, was signed into law by Governor Edmund G. Brown on May 14. In will become operative on July 1, 1964.

The Division of Highways is now in process of preparing a base map illustrating the new route designations. The map will be made available to firms and organizations publishing information for motorists.

As the new federal interstate highway projects become a complete system, the red, white, and blue interstate signs will replace some of the familiar U.S. sign routes (U.S. 40 will become Interstate 80, U.S. 91 will become Interstate 15). In most other cases, the old established state sign route number or noninterstate U.S. route number will become the legal as well as posted number for the highway.

The new route designation map, will not be available until late this summer. Although the renumbering bill has been signed into law, there are other bills affecting highway routes which may be under legislative consideration until late in June.

Stockton Model

New Display Shows One Type of Freeway Design Being Considered

By THOMAS T. WHITE, Senior Delineator



A scale model showing one type of freeway construction now under consideration for the proposed Stockton Freeway has been on public display in the community after serving its original purpose of assisting in design studies for the project.

The model has aroused considerable public interest, and has been viewed by an estimated 45,000 persons to date. It has been displayed in banks, at service club luncheons and on television. The San Joaquin County Fair Association has requested that it be displayed at the county fair in August.

Although experienced engineers can visualize three-dimensional views of complex interchanges from the usual two dimensions, the model makes it easier for all concerned to work out the myriad of details that go to make up a modern traffic interchange. For instance, the model has helped in planning the relocation of utilities and studying the complicated grade systems and drainage patterns within the interchange areas. Study of the model has also been helpful to the designers in planning the sequence of construction operations and the handling of public traffic in each construction stage.

The model has of course helped immeasurably in explaining to individual property owners how their property might be affected and what it might look like after the freeway has been completed.

The model is 4 feet wide and 40 feet long. It was constructed on 4-foot by 10-foot sections for ease of handling and transporting. The scale is 1 inch = 50 feet. The base of the model has two layers consisting of ¼-inch plywood on the first layer and ⅜-inch firtex on the second layer. The plywood gave the model rigidity while the firtex allowed for easy cutting of waterways and depressions.

The existing topographic features were made by gluing ozalid plastic prints of blown-up aerial photographs of the model area directly on the firtex. Household plastic type cement was used because of its fast-drying, nondistorting qualities. The buildings were carved from balsa wood, painted in their true colors, and glued in their respective locations upon the base aerial map.

Since the height of the buildings in the downtown area was not readily available, a photographic method was worked out for proportions. The buildings were photographed in individual groups from the ground with a stadia rod in a vertical position against one of the buildings in each group of photographs. This provided a visual scale for height.

The centerlines of the interchanges and the main roadways were laid out on the base map so that the structures and embankments of the freeway could be placed in their proper location. The fills were made of firtex, shaped with a wood rasp, using the profile grade as a template for height. Structure decks were cut to size from matboard and cardboard. The bridge piers were made of standard size nails chosen for correct diameter and length, and subsequently painted. Bridge rails and the freeway pavements were made of cardboard and painted gray with a water base paint.

Norwegian lichen, an imported reindeer moss used by model railroad enthusiasts for miniature reproduction of trees and shrubs, was used to landscape the fill slopes and the vacant areas within the interchanges. Various types of colored plastic tapes of proper width were used for traffic lanes and railroads. City streets adjoining the freeway to be improved, were shown by photographic black tape simulating an asphaltic concrete appearance.

The cost of labor and material for constructing this model was $2,500. It was built by Robert Miller and Amando de la Rosa of the delineation section of the advance planning department of District X.

PHOTO BELOW. Freeway design display in Stockton bank lobby draws spectators.



Reflective Markers

Epoxy, Polyester Buttons Aid Nighttime Visibility

By HERBERT A. ROONEY, Senior Chemical Testing Engineer

It has long been known and observed by motorists that during periods of inclement weather and moderate-to-heavy rainfall that water tends to accumulate on the pavement to a depth sufficient to cover and obscure the beaded painted centerline traffic stripe. Under such conditions, the refractive index is changed and light from a motor vehicle is not reflected back to the driver and he is unable to see the painted stripe. In this situation the driver often finds it difficult to remain in his traffic lane.

Beginning in 1954, the materials and research department began experimentation with the installation of reflectorized white "buttons" or markers, made of epoxy or polyester resins according to the Division of Highways' specification, four inches in diameter and three-fourths of an inch high, the convex shape corresponding to the outer segment of a sphere as shown in Figure 1 and Photograph No. 8. These buttons were cemented to the highway surface with an epoxy adhesive, one each in the center of the 15-foot gap in the broken painted stripe. In theory these elevated markers "shed the water" and are not readily submerged. Such markers are considered as auxiliary devices which provide adequate delineation during periods of wet weather, the normal painted stripe being considered thoroughly adequate in clear weather.



PHOTO 1. Buttons on the pavement at nighttime, clear weather.

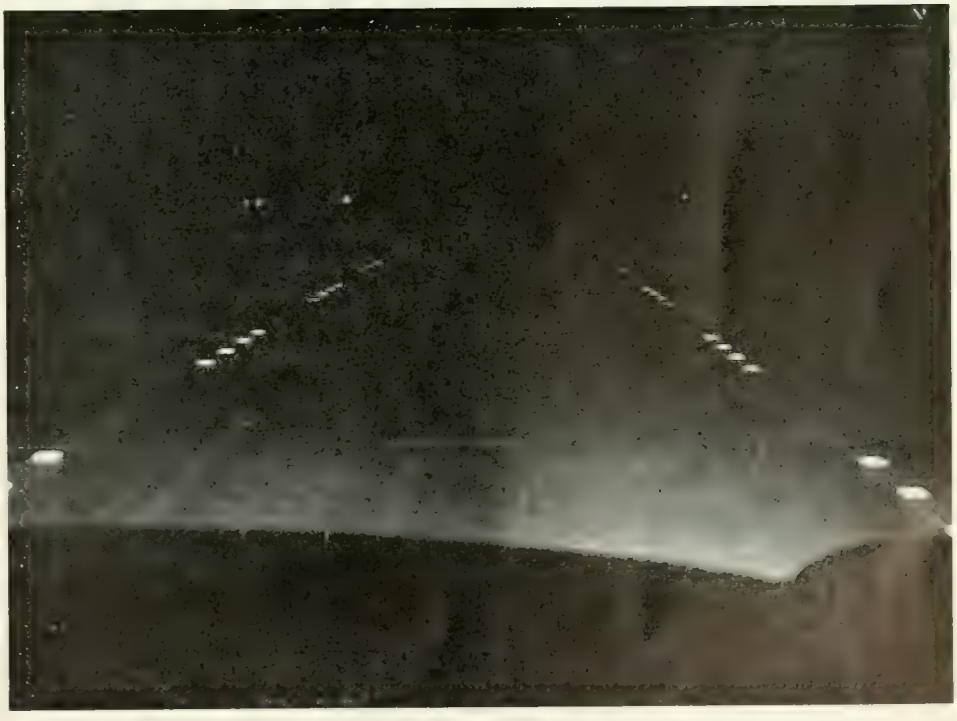


PHOTO 2. One-way wedges on the pavement at nighttime, clear weather.

20-year Service Life

Performance since 1954 indicates that these markers should have a service life of at least 20 years on portland cement concrete highways. On asphaltic concrete their life is dependent upon the cohesive strength of the asphaltic concrete. In hot climatic areas some failures have occurred whereby, under the impact of traffic, the markers broke loose carrying with them portions of asphaltic concrete attached to the markers. Preliminary data show that suitable nails or spikes driven

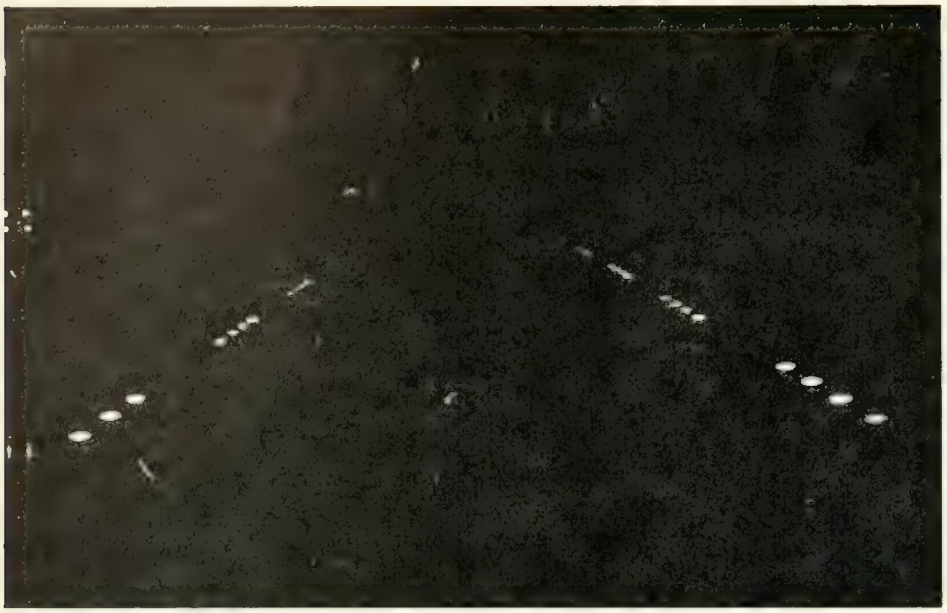
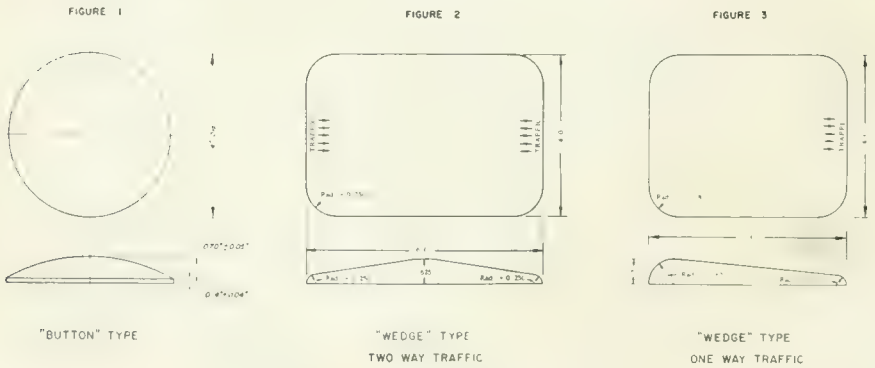


PHOTO 3. Buttons on the pavement at nighttime, moderate rain.



PHOTO 4. One-way wedges at nighttime, moderate rain.



REFLECTIVE PAVEMENT MARKERS

into the asphaltic concrete under the bottom of the marker before it is cemented in place may prevent this.

Beginning in 1955 a test section was installed in which "wedge" type markers, as illustrated in Figure 3 and Photograph No. 6, were used as a complete replacement for a painted stripe on a portland cement concrete divided freeway. In this test section the distance between wedges varied, the extreme spacing being one wedge every 24 feet. All later installations had four markers, each three feet apart in the nine-foot sections where the normal stripe usually occurs. Some of these installations used the beaded wedges and others the beaded buttons. Two-way wedges as shown in Figure 2 and Photograph Nos. 5 and 12, except that they were beaded, have been used on two-lane roads or as a no-passing line on nondivided freeways in which latter case they would be yellow in color and two cemented adjacent to one another. Photograph Nos. 1 and 2 show clear weather nighttime delineation provided by the button and one-way wedge markers respectively and photograph Nos. 3 and 4 illustrate nighttime visibility of these markers during a moderate rainstorm. In another photograph taken in this area where a painted stripe was placed, the painted stripe was completely invisible.

Report Is Prepared

A "Report on a Study of Highway Dividing (Lane) Markers" was prepared by the materials and research department of the Division of Highways in co-operation with the Department of Motor Vehicles and the California Highway Patrol and submitted to the California Legislature in January 1963 in response to House Resolution No. 462 of the 1961 Regular Session. House Resolution No. 462 requested a study be made of methods and materials used or useful for markers which divide the highways of this State, for the purpose of finding or devising methods and materials which would render highway markers more easily seen at night and during periods of inclement weather.

The above report described work done by the materials and research department on this problem since 1936

TABLE I

RESULTS OF OBSERVATIONS * OF VARIOUS TYPE MARKERS ON PORTLAND CEMENT CONCRETE ON III-SAC-11-B,A

Weather condition	*Shape of marker*	*Beaded type*		*Nonbeaded type*		*Partially beaded and nonbeaded type*	
		Daytime	*Nighttime*	*Daytime*	*Nighttime*	*Daytime*	*Nighttime*
Fair	Button	Poor	Very good	Good	Poor	Fair	Fair
	Wedge	Fair	Excellent	Very good	Poor		
Rain	Button	Poor	Excellent	Very good	Good	Fair	Fair
	Wedge	Poor	Very good	Good	Good		

* Observations made after submission of legislative report.

and listed certain tentative conclusions concerning the use of such markers. These conclusions are based upon criteria as to whether the markers are to replace the painted stripe or are to act as a supplement to the stripe for wet weather delineation of the center line. If these markers are to replace the painted stripe they must provide the following:

1. Adequate delineation in the daytime in both clear and inclement weather.
2. Adequate delineation at night in both clear and inclement weather.
3. They must have a service life commensurate with the cost of the installation.

In the summer of 1962 a two-mile test installation of reflective pavement markers in lieu of a painted stripe, was made on III-Sac-11-B,A., a six-lane divided concrete highway surface near Nimbus, about 10 miles east of Sacramento on U.S. Highway 50. In this test installation the following types of markers were installed in an effort to determine which type or types would provide the best delineation day and night in all types of weather, in the absence of a painted stripe. Photograph Nos. 6 to 11 inclusive, show closeup views of these various types of markers.

Photograph No. 6 — Glass-beaded white wedge.

Photograph No. 7—Plain white nonbeaded wedge.

Photograph No. 8 — Glass-beaded white button.

Photograph No. 9—Plain white nonbeaded button.

Photograph No. 10—Plain white top button with glass-beaded white rim.

Photograph No. 11 — Glass-beaded white top button with plain white nonbeaded rim.

In two of the test sections, three of the four markers in the nine-foot length where the painted stripe normally occurrs were nonbeaded, and the fourth marker contained high index of refraction glass beads. The object of using nonbeaded markers is that they provide better daylight delineation than do beaded markers, the latter scattering the sunlight thereby giving them a grayish appearance, which on portland cement does not provide adequate contrast with the concrete.

Night Visibility

At night, in clear weather, the reverse is true; the beaded markers show very well whereas the nonbeaded ones are hardly visible. In order to provide greater safety at night those test sections containing three nonbeaded and one beaded marker were changed three months later wherein two of the markers were beaded and two nonbeaded, the two types alternating in the nine-foot section. The partially beaded markers listed above and shown in Photographs Nos. 10 and 11, are an attempt to compromise the advantages and disadvantages of the beaded and nonbeaded types. Table I is a summary of the observations of the various types markers used on III-Sac-11-B,A.

Research to date indicates that the best combination of markers, in the event the painted stripe is eliminated, would consist of four markers spaced three feet apart in the nine-foot length where the painted stripe normally occurs, the markers being alternating beaded and nonbeaded wedges. If the markers are used to supplement the standard painted stripe, a minimum of three markers, preferably the beaded button type, spaced three feet apart in the 15-foot gap in the painted line would provide effective delineation for all light and weather conditions.

Overhead Lighting

Where overhead lighting is used such as in tunnels, on bridges and interchanges, reflectorized beaded markers or a beaded painted traffic



PHOTO 5. Two-way wedges, white nonbeaded, on the roadway of the Webster Street Tube.

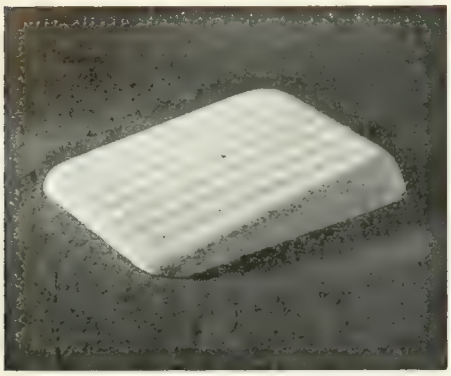


PHOTO 6. Glass-beaded white wadge.



PHOTO 9. Plain white nonbeaded button.

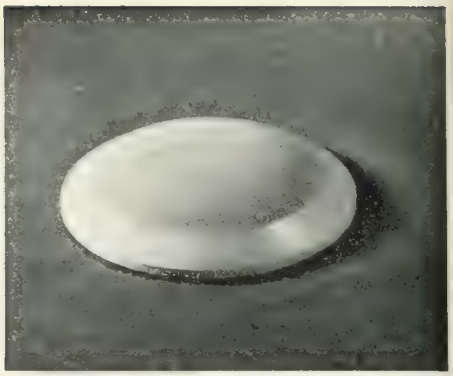


PHOTO 11. Glass-beaded white top with plain white nonbeaded rim.



PHOTO 7. Plain white nonbeaded wedge.

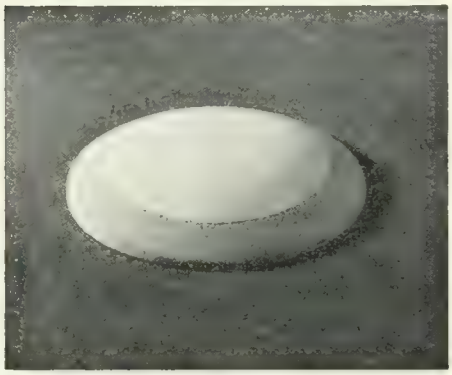


PHOTO 10. Plain white top button with glass-beaded white rim.

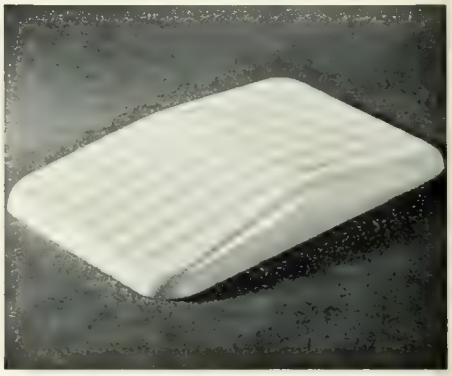


PHOTO 12. Plain white nonbeaded wedge.

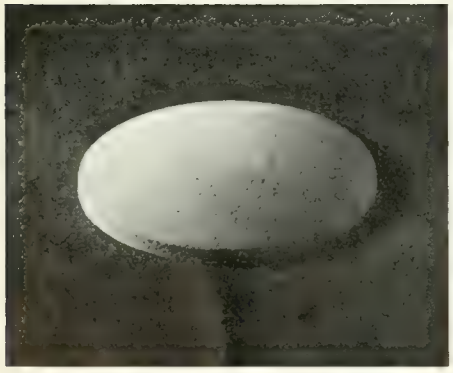


PHOTO 8. Glass-beaded white button.

stripe do not delineate properly because of the scattering of the overhead lighting by the glass beads. In situations of this type, the best delineation is provided by nonreflectorized white markers, preferably the wedge-shaped type which more adequately defines a line. An installation of this type is shown in Photograph No. 5 which illustrates the use of white nonbeaded wedges in the new Webster Street Tube in Oakland.

Many trial installations have been made in the various districts of the Division of Highways throughout the State to determine the effectiveness of the markers under varying climatic, weather, and traffic conditions. These markers are under continuing surveillance by district personnel. In addition to comments on the effectiveness of the markers for delineation, most districts have commented favorably on the markers for the rumbling noise caused by traffic riding over them. This appears as an added safety factor in alerting motorists when they are crossing over a lane line.

A new rectangular marker combining the advantages of both the wedge and the button has just been developed and it is anticipated that a trial installation will be made to evaluate its effectiveness.

Development work on the markers is continuing and the Division of Highways will continue its efforts to provide the most economical and effective lane markings for all climatic and roadway conditions.

Author's Acknowledgments

These markers are a development of the Chemical Unit of the Central Laboratory, Technical Section, under the direction of Donald L. Spellman.

Appreciation is due F. N. Hveem, head of the materials and research department, for his suggestions and interest in promoting research relative to providing greater highway safety through better delineation of highway center lines; to the late Dr. E. D. Botts, former senior chemical testing engineer in this department who pioneered in the development of reflective pavement markers; to Robert Souza, staff photographer for the excellent photographs accompanying this report; to Enrico Maggenti, engineering aid II, for his conscientious work in directing the field installation of the test sections; and to James A. Cechetini, materials and research engineering associate, for his work in 1955 in designing the reflective wedge-type marker.

Sacramento River Canyon

By ELLIS C. ENGLE, District Construction Engineer



Another section of Highway U.S. 99 (Interstate 5) between Redding and Dunsmuir has been constructed to modern four-lane standards. With the completion of this six-mile unit south of Castella, there now exists approximately 30 miles of continuous four-lane expressway and freeway for use by the traveling public.

Total construction cost for this 30-mile section was approximately $30,790,000.

In 1954 the Division of Highways started reconstruction of the portion of U.S. 99 betwen the north end of Shasta Lake and Dunsmuir. For a distance of 30 miles the existing highway was located in the rugged canyon of the Sacramento River. Also located in the canyon were the mainline tracks of the Southern Pacific railroad, high-tension transmission lines, and a coaxial telephone cable.

Completed section of expressway at Pollard Gulch. Note old highway and bridge on the left.

Stability Is Determined

Providing room for a modern four-lane highway, at the same time keeping disruption of existing facilities to a minimum, taxed the ingenuity of the design engineers. The modern alignment and grades required high cuts and fills, and as the work progressed in the canyon extensive investigations were made by the materials and research department to determine the stability of fill foundations and cut slopes.

The first contract, for construction between Vollmers and La Moine, was let to Piombo Construction Company; the contract for the bridge at Dog Creek, to Ukropina Polich and Kral and Ukropina; and the one for the section between Crespos and Vollmers, to Guy F. Atkinson. These three contracts provided for the construction of seven miles of 60-foot all-paved section with intersections at grade but no private access. Total quantities of earthwork amounted to 2,500,000 yards.

Problems Become Apparent

The problems that were to trouble the construction engineers became ap-

CANYON ROUTE HISTORY—FIRST ROAD BUILT IN 1858

By MARK E. CESSNA, Associate Highway Engineer

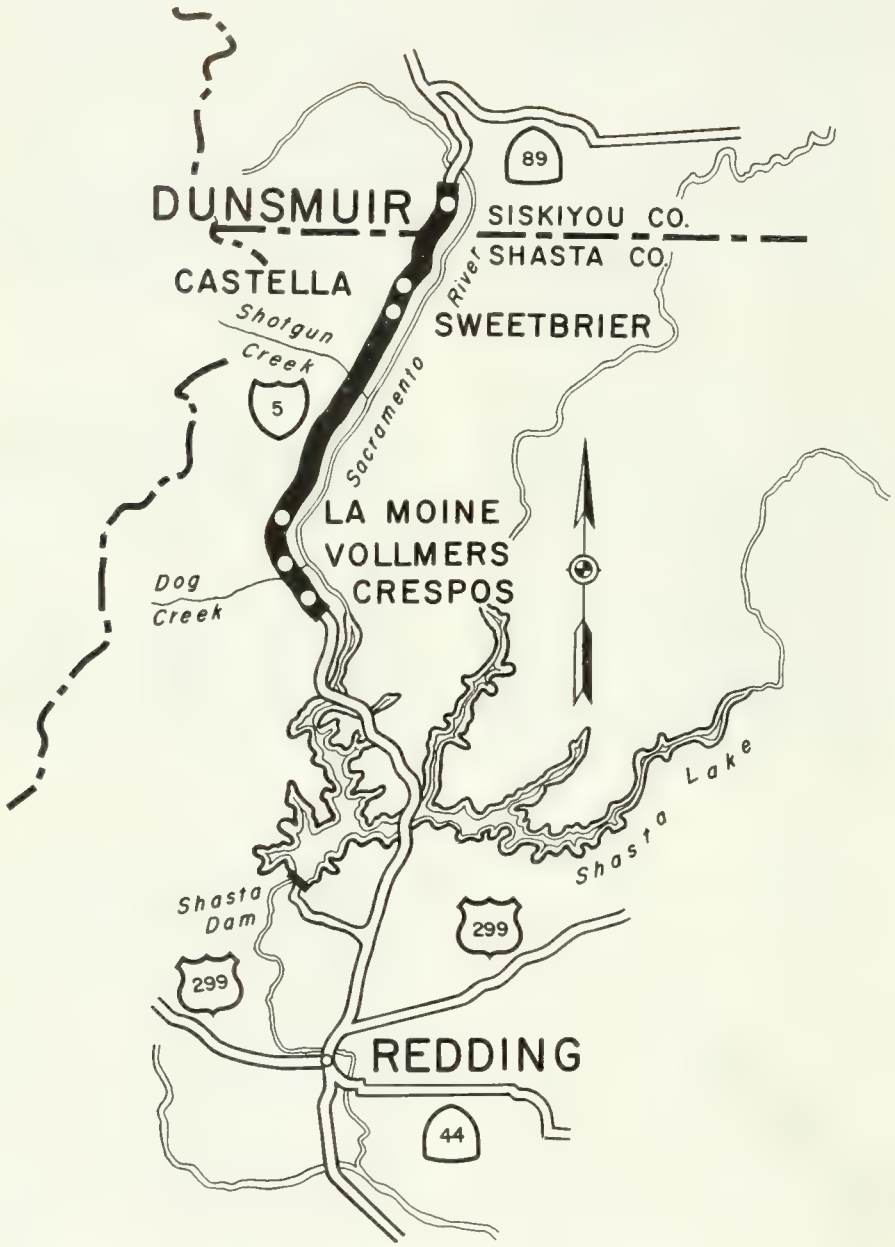
(Editor's Note: This historical account rounds out the background material contained in "Sacramento Canyon," which appeared in the May-June 1956 issue.)

The history of travel in the Sacramento River canyon between the great Central Valley and the uplands of far northern California prior to 1837 is somewhat sketchy. Although this route must surely have been used by hunting and war parties of the Wintu and other Indians, since it is the most direct route between the fertile Central Valley and the semiarid upland plateau, there is no positive evidence to support this belief.

Recent discoveries in ancient burial mounds near the City of Sacramento indicate that neolithic man also inhabited this fertile valley, and since he

. . . Continued on page 23





The heavy black line on the above map shows the location of the freeway construction on Interstate 5 (U.S. 99) through the Sacramento River Canyon described in this article.

parent at this time. The winter of 1955-56 with its heavy rainfall caused numerous large slides and one slipout of a major fill. These were corrected by the installation of horizontal drains and the shifting of the line into the hill. However, in the early stages of the next section between La Moine and Shotgun Creek, constructed by Gibbons and Reed in 1957 and 1958, it became apparent that more extensive measures of correction would be necessary to stabilize the foundations for the deep fills. Large amounts of underground water, seams of decomposed serpentine, and highly plastic clays not only provided poor foundations for large fills, but also caused extensive slides. Some of these conditions existed 40 to 50 feet below the original ground on steep hillsides and were not susceptible to correction by ordinary means.

Numerous auger borings were made to determine the underground conditions. Corrective steps were undertaken after consultation with the materials and research department. These steps, although expensive, were justified to prevent the possible loss of a major fill with consequent disruption of traffic and perhaps the closing of the railroad. These remedies were then made a part of the design for the remaining three projects in the canyon.

Corrective Measures

Corrective measures consisted of constructing stabilization trenches under the high fills where borings indicated the existence of unstable conditions. In areas where stabilization trenches were not considered feasible, a system of vertical wells (see photo) 24 inches in diameter were drilled and filled with filter material and perforated pipe to collect the water. These were then intercepted with horizontal drains at a lower elevation to drain the water from the hillsides. Extensive use was also made of underdrains to stabilize the subgrade areas.

The efficiency of these measures has been shown by their effectiveness at the old Shiloah slip a few miles north of La Moine. This slipout, which had caused a large expense to the maintenance department, was started by the placing of only 2,500 yards of fill during reconstruction of the road in 1928. It had been necessary every year since that time to restore the roadway to grade by the addition of one to three feet of material, depending on the severity of the season.

Since the completion of the new contract at that location in 1959 no settlement has occurred. Corrective measures at this location consisted of a stabilization trench, horizontal drains into the hillside, and strut material placed on the downhill side of the fill.

Runaway Truck Hazard

After the Gibbons & Reed contract at Shotgun Creek, construction was shifted to the Dunsmuir area due to the desirability of eliminating the hazards of runaway trucks through Dunsmuir as soon as possible. This section was built by McCammon & Wunderlich. The design of this section was on the basis of a full freeway.

The typical section included a 16-foot median, 2 12-foot lanes of 8-inch portland cement concrete in each direction, and 10-foot shoulders on the



Looking north along the new freeway toward Mount Shasta with the City of Dunsmuir in the middleground.



BEFORE. Section of old highway near Sweetbrier. Mount Shasta in background. Note retaining walls on right to prevent encroachment on railroad.



AFTER. Same section as above after freeway was completed. Sweetbrier Interchange in background. Clouds veil Mount Shasta in distance.

right of traffic paved with asphaltic concrete. The remaining two sections in the canyon were designed to the same standards. The section between Sweetbrier and one mile south of the Shasta county line was constructed by Gibbons & Reed and the last section, between Shotgun Creek and Sweetbrier, by Slate-Hall & Hamilton.

The concrete pavement on these three contracts was placed by Gordon H. Ball, Inc., using the slip-form paver.

Several large slides developed during construction which required extensive corrective measures. These consisted of flattening cut slopes; unloading the tops of the slides; installing horizontal drains; and in one instance, where the foot of the slide was on stable material, placing a rock buttress for additional support. In some cases a combination of all these measures was necessary to stabilize the slides.

At one location the existing highway was cut in a steep sidehill section on the left side with retaining walls on the right side. This was to prevent encroachment on the main line of the Southern Pacific railroad which was approximately 125 feet below and immediately adjacent to the Sacramento River.

350-foot Cut

The new construction entailed a 350-foot cut on the left with 20-foot wide benches at 40, 100, and 180 feet above roadway grade. Cut slopes were ¾ :1 to the first bench and 1 :1 slopes above.

When construction had progressed to within 100 feet of grade, what appeared to be a small slide developed in the cut slope between the 100- and 180-foot benches. As work continued in the cut it became evident that the slide was quite extensive and would require major corrective action. Large cracks had developed in the hillside approximately 850 feet from centerline and 550 feet higher in elevation. The first proposal to flatten the cut slopes and unload the slide area, was not deemed feasible for the following reasons:

Although large amounts of ground water were present, it was not believed that horizontal drains would be

effective. The movement, while aggravated by the wet conditions, was primarily a bedding plane slide. The district drill crew took borings above the cut slope to determine the extent of the unstable material. This investigation disclosed that the conditions were more critical than originally anticipated. Flattening the cut slopes would require from 600,000 to 1,000,000 cubic yards of excavation, with no assurance that this would stabilize the slide. In addition no disposal areas were available for this large amount of material without excessive haul over existing roads.

Railroad Alignment Shifted

It was then decided to investigate the possibility of moving the new location away from the slide area. In order to accomplish this it would be necessary to move the main line of the Southern Pacific railroad and construct a new channel for the Sacramento River. A preliminary study by the district design department indicated that it was feasible to shift the alignment approximately 150 feet away from the hill and move the railroad tracks and the river. The material removed from the new channel could be used to construct the new railroad grade, and since the new alignment of the freeway was primarily in fill it would permit the unoriginally designed cut slope to obtain loading of the slide area above the the necessary material for the embankment.

This solution to the problem was chosen because it provided slightly improved alignment and grade on the new freeway, eliminated the large excess of material for which insufficient disposal areas were available, eliminated a future maintenance problem by creating a storage area between the unstable cut slope and the new roadway, and was an overall economy over other corrective measures.

Traffic Also a Problem

In addition to the problems encountered due to unstable terrain, the handling of traffic throughout, presented quite a problem. In general the specifications provided for a two-lane paved road for traffic at all times.



Slide removal operations at site of big slide. Railroad has been relocated from original location at base of bluff under retaining walls.



Vertical drainwell installation in Dunsmuir. Pipes were capped and a pervious blanket placed over area.



Looking north along the new freeway toward Castle Crags State Park (left). Castella and the old highway are to the right. Grading operations underway at Pollard Gulch approximately two miles north of La Moine. Concrete arch bridge replaced with 6-foot reinforced concrete arch.



While it was necessary for the contractors to stop traffic for short periods of time, it soon became apparent that it was to the contractors' advantage to keep traffic moving as the delays to their operations were extensive in trying to clear long lines of traffic.

In general the system used was to construct the cuts or fills to the level of the existing road, pave these portions, and then shift traffic to the outside, thereby providing room for the construction of the remaining two lanes of the freeway to grade. These were then completed through the leveling course stage on the projects paved with asphaltic concrete, and traffic was again shifted to allow the completion of the remaining lanes. On the projects paved with concrete, temporary surfacing was placed over the subbase to carry traffic while completing the remainder of the roadway grading.

Work is continuing at present on the conversion of the two-lane highway around Shasta Lake to modern four-lane standards. Piombo Construction Company is constructing several underwater rock fills where the new embankments encroach on small inlets of the lake. When this work is completed additional contracts will be let to complete the section between the Pit River Bridge and the completed work in the canyon, a distance of approximately 14 miles.

CANYON ROUTE HISTORY

Continued from page 17 . . .

was such a great traveler in Europe, it is reasonable to assume that he also used the Sacramento River canyon in his travels. But it was not until one Michael LaFamboise in 1837 pioneered the first trail that this route became an accepted highway of commerce. To call this first trail a highway would seem to be stretching the point a bit, but soon after its opening it did become an important commercial route.

In 1841, Lieutenant George F. Emmons, U.S.N., a member of the official U.S. Government Around the World Exploration Party under Lieutenant Charles Wilkes, explored and mapped this trail from San Francisco Bay to the mouth of the Columbia River. It is interesting to note that Lieutenant Emmons gave the Sacramento River the name Destruction River from its junction with the Pit to its source. At first glance of the canyon through which the Sacramento River passes in this portion, it is not hard to see how he came by this name.

In 1854, the first toll company franchise was granted for a portion of this route north of Soda Springs. With the opening of the so-called stageline between Shasta and Yreka in 1858, travel over this route so increased as to warrant the construction of more of these toll roads, some of which must have been successful commercial ventures. (The phrase "so-called" is used with reference to the first stageline because the portion between the Pit River and Soda Springs was traversed by mule back instead of by coach. This portion being about 40 miles in length over very rough country, there is much speculation as to the condition of the passengers when they arrived at Soda Springs. To say that they must have been sorely worn is surely an understatement.)

Bridges Washed Out

In 1861, this portion of the road was completed, only to have its eight bridges washed out by the great flood of the 1861-62 winter. Even in those days inadequate hydrologic data was the bane of the roadbuilder.

In 1860, Ross McCleod, the operator of the Soda Springs Resort, promoted the survey and construction of a road from Soda Springs to Yreka.

The standards adopted by these early highway builders were a full 8- to 11-foot roadbed with maximum grades of 25 percent. Construction costs were estimated to be in the neighborhood of $300 per mile. An occasional turnout was provided to facilitate passing, and the great clouds of dust that were stirred up by traveling vehicles were ample warning of approaching traffic. Meetings at these turnouts gave welcome excuse to rest a traveler's team and exchange news. The time required to traverse the canyon was between two and four days, depending on the load carried and the amount of news exchanging that went on during these rest periods. By 1914, the road had deteriorated so badly, because of lack of maintenance, that it became impassable for long periods of time and traffic had to be diverted over longer routes. Such were conditions in the Sacramento River canyon when the California Highway Commission was formed.

Route Recommendations

The first duty of Mr. T. A. Bedford, district engineer of the newly formed District II, was to make recommendations as to the best route between the Town of Redding in the central valley and Yreka on the northern plateau. In 1913, there was considerable agitation for this route to be constructed west from Redding through French Gulch, Trinity Center, and Carrville, over Scott Mountain, through Fort Jones to Yreka. Mr. Bedford ruled out this route as being considerably longer with more adverse grade, making it much more expensive. In addition, the traffic on this route did not warrant making it the primary route.

In the years between 1914 and 1919, construction of the road between Redding and Dunsmuir was carried on at a feverish pace. The new road, to quote from a preliminary report of that era ". . . has a very good alignment considering the character of the country which renders it impossible to procure a more direct line. The minimum radius of curvature is



The original state highway through the Sacramento River Canyon was constructed nearly 50 years ago with pick and shovel labor and horse-drawn scrapers.



Looking north from top of large slide at Sweetbrier. Bulldozer approximately 500 feet above grade. This was area where channel change was made and railroad relocated.

60 feet. The maximum grade is 6.7 percent." This in contrast to another report describing the condition of the old road, ". . . the existing road has a very crooked alignment with curves as sharp as 20-foot radius and many pitches of grade running up to 20 percent."

Early Contracts

These early contracts seemed to have been plagued with the same troubles as those of the present day, *i.e.*, too much subsurface water and slides. In the final report of one of these contracts, it was found that about one-fourth of the total earth moved came from slides occurring in the winter.

Two Concrete Sections

From 1923 to 1929, surfacing and realignment contracts were let on this portion of the route, even to the extent of paving two portions with portland cement concrete pavement. But for the most part, this surfacing consisted of gravel which the maintenance department later oiled.

By 1932, conditions of the route had improved to the point that when Mr. F. W. Haselwood succeeded Mr. H. S. Comly as district engineer, the latter remarked that there was nothing to worry about in the canyon since that highway was completed and would need no more attention.

Shasta Dam Construction

The construction of Shasta Dam, the largest unit of the Central Valley Project, initiated another era of road improvement in the canyon. The construction of the dam made necessary the relocation of 19.5 miles of highway through rough, forbidding terrain which earlier locators did not have the temerity nor the need to attempt. A note of interest is that this relocation follows the old Oregon Trail road. This section of road is a highly improved two-lane section with moderate grades and curvature, but it contains some of the heaviest grading undertaken on a two-lane highway in District II. This section, completed in 1943, is still in fair condition and may be traversed by the traveling public with very little delay.

Older Portions Improved

With the tremendous increase in traffic on the highways of California following World War II, it became increasingly more apparent that the older portions of the highway in the canyon would soon need improvement. Therefore, in the autumn of 1951, a special projects section was organized in District II to begin preliminary studies and prepare plans for the realignment and reconstruction of U.S. 99 in the Sacramento River canyon to a multilane facility.

Same Problems

"It soon was discovered that the same problems were still there, namely the river, the Southern Pacific railroad, and the springy, unstable areas," to quote R. H. Twaddle, design engineer for this section. By 1954, plans had progressed to such a point that the first section was begun, starting at Dog Creek near the head of Shasta Lake. Each successive year as more funds became available, additional sections were let to contract.

The section between the north end of Shasta Lake and Dunsmuir has now been completed providing 30 miles of freeway and expressway through this scenic but extremely rugged canyon.

Bay Area Report—1963

By J. P. SINCLAIR, Assistant State Highway Engineer



The best descriptive phrase that can be applied to highway development within the San Francisco Bay area in recent years is that of "reaching out." Where less than two decades ago we found traffic inching along historic routes designed for traffic conditions of the 1930's, today many of these routes have been improved to high-standard freeways connecting the important residential, commercial and industrial centers of the Bay area.

To visualize these improvements, think of the conditions existing at the close of World War II. The Bay area, which for almost five years had served as an important center for support of military operations, was long overdue for improvements in its transportation system. Peaceful suburban towns surrounding the financial centers of the Bay, San Francisco and Oakland, were about to explode into densely populated and highly developed areas.

Old Highways Congested

Highway facilities in the area, in the main, consisted of two-lane, at best four-lane, roads connecting the Peninsula, Marin and East Bay communities. Within the cities, streets served as arteries for highway traffic which was continually hampered by traffic to and from adjacent commercial properties.

On the Peninsula, two main routes served the commuter and through traffic between South Bay points and San Francisco. One of these routes, Bayshore Highway, authorized by the Legislature in 1923, traversed the marginal tidelands on the west side of the Bay. Farther to the west, tree-lined



Candlestick Park on the opening day of the 1963 baseball season. The view is westward across the peninsula with the Bayshore Freeway crossing in the middleground and the Southern Freeway-Alemany Boulevard interchange visible to the right.



BEFORE. The Bayshore Highway in 1953 at the Third Street intersection. The view is northward. (See photo below.)

El Camino Real wound its way along the base of the hills connecting communities and serving as their main street. Skyline Boulevard, along the spine of the Coast Hills, and the Coast Highway (State Sign Route 1), winding along the Pacific shore, generally served the weekend travelers seeking recreation and the wonders of nature.

In the East Bay, city streets such as San Pablo Avenue and East 14th Street served north-south traffic including heavily traveled U.S. 40 through Richmond. Farther south, Hesperian Boulevard, little more than a country road through the fields, and Mission Boulevard, along the east foothills, connected Oakland and San Jose. MacArthur Boulevard served traffic to and from the Livermore Valley and points east. Ashby Avenue and Broadway were the thoroughfares to the walnut groves east of the Berkeley Hills.

Right Angle Turns

North of the Golden Gate, U.S. 101 wound lazily through the communities of Marin and Sonoma Counties while State Sign Route 1 hung tenaciously to the cliffs above the Pacific. The remaining routes within Marin and Sonoma Counties were little more than paved paths along land section boundaries with right angle turns every few miles.

Today, as one views the existing freeway and expressway system, the improvements in the past 15 years are almost phenomenal.

Commuter traffic is now rapidly distributed throughout the commercial and financial districts of the metropolitan area by the Embarcadero, Central and James Lick Memorial Freeways in San Francisco and the MacArthur and Nimitz Freeways in the East Bay.

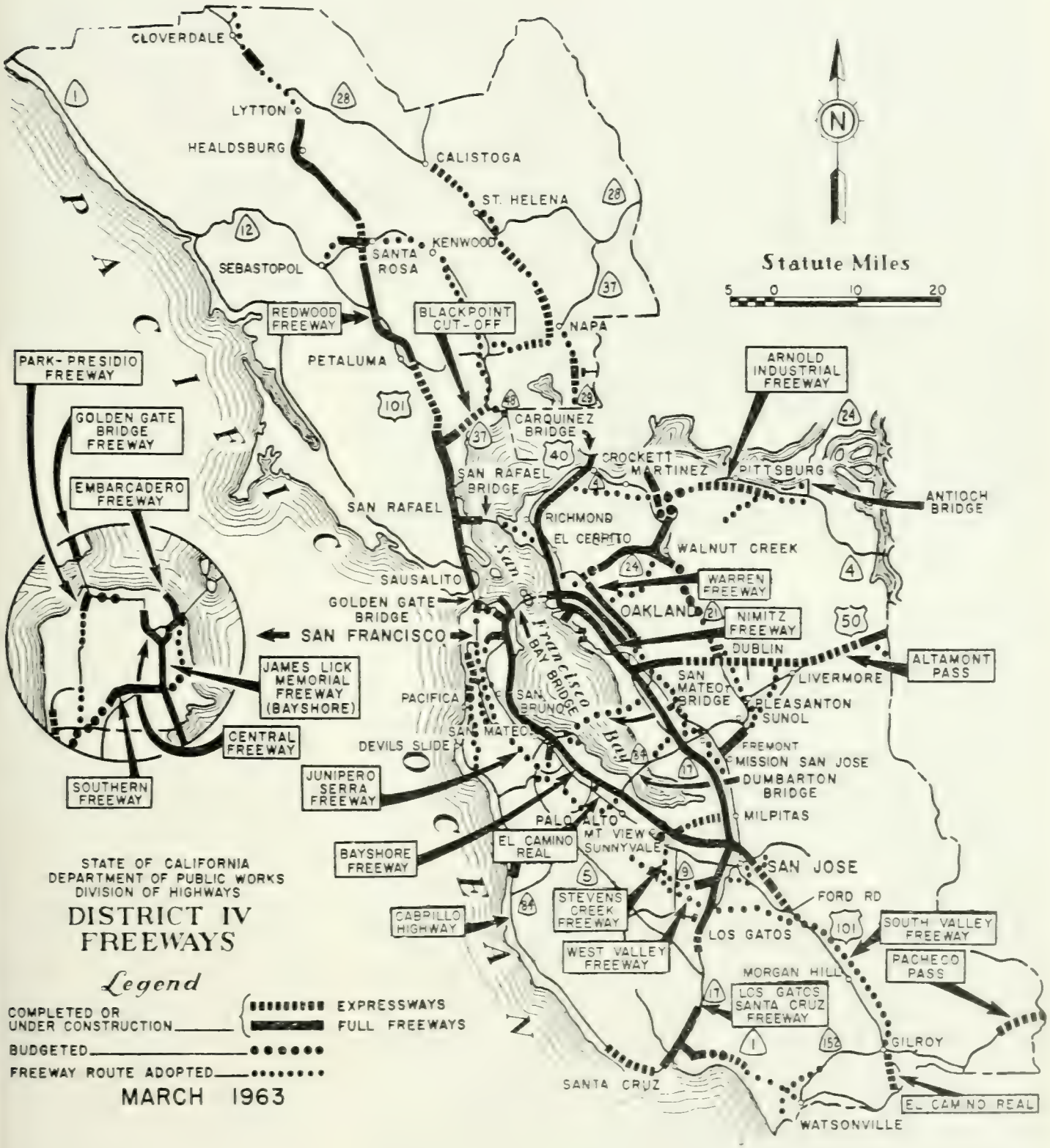
In San Jose, State Sign Route 17 handles much of the traffic that formerly was confined to city streets and Bayshore and Nimitz Freeways serve the outlying areas which are being rapidly developed. Routes have been adopted for the Guadalupe Parkway and the Route 5 Freeway which will serve traffic within the city core area. Also within San Jose, two units of the Junipero Serra Freeway, an eight-lane interstate facility connecting San Jose and San Francisco, are under construction and a third has been budgeted.

Becomes Freeway

Bayshore Highway has been developed into Bayshore Freeway, connecting San Francisco with San Jose and points south. This is a continuous six-lane, sometimes eight-lane, facility and further improvements are planned. Portions of El Camino Real have been improved to six-lane divided conventional highways with parking aprons



AFTER. The present Bayshore Freeway looking northward toward the Army Street interchange. (See photo above.)


CLOVERDALE
LYTTON
HEALDSBURG
CALISTOGA
ST. HELENA
SEBASTOPOL
SANTA ROSA
KENWOOD
NAPA
PETALUMA
REDWOOD FREEWAY
BLACKPOINT CUT-OFF
PARK-PRESIDIO FREEWAY
GOLDEN GATE BRIDGE FREEWAY
EMBARCADERO FREEWAY
SAN RAFAEL
SAN RAFAEL BRIDGE
CARQUINEZ BRIDGE
CROCKETT
MARTINEZ
PITTSBURG
ARNOLD INDUSTRIAL FREEWAY
ANTIOCH BRIDGE
RICHMOND
EL CERRITO
WALNUT CREEK
WARREN FREEWAY
SAUSALITO
GOLDEN GATE BRIDGE
SAN FRANCISCO
OAKLAND
NIMITZ FREEWAY
DUBLIN
ALTAMONT PASS
LIVERMORE
PLEASANTON
SUNOL
SAN MATEO BRIDGE
JAMES LICK MEMORIAL FREEWAY (BAYSHORE)
PACIFICA
SAN BRUNO
SAN MATEO
DEVILS SLIDE
CENTRAL FREEWAY
SOUTHERN FREEWAY
JUNIPERO SERRA FREEWAY
FREMONT
MISSION SAN JOSE
DUMBARTON BRIDGE
MILPITAS
PALO ALTO
MT VIEW
SUNNYVALE
BAYSHORE FREEWAY
EL CAMINO REAL
SAN JOSE
STEVENS CREEK FREEWAY
CABRILLO HIGHWAY
FORD RD
LOS GATOS
SOUTH VALLEY FREEWAY
WEST VALLEY FREEWAY
PACHECO PASS
MORGAN HILL
LOS GATOS SANTA CRUZ FREEWAY
GILROY
SANTA CRUZ
EL CAMINO REAL
WATSONVILLE
N
Statute Miles
5 0 10 20
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
DISTRICT IV
FREEWAYS
Legend
COMPLETED OR UNDER CONSTRUCTION
EXPRESSWAYS
FULL FREEWAYS
BUDGETED
FREEWAY ROUTE ADOPTED
MARCH 1963

JUL 8 - 1963



New freeway section of U.S. 101 in Sonoma County at the East Fulton Road overcrossing, completed in 1962.



Traffic entering and leaving the recently completed Webster Street Tube between Oakland and Alameda. New tube is carrying two-way traffic during modification of the existing Posey Tube.

and sidewalks to serve an almost continuous community along its length. Skyline Boulevard for much of its length in San Mateo County will become the Junipero Serra Freeway. Along Cabrillo Highway, portions have been developed to expressway standards and the first freeway section in the City of Pacifica will be constructed shortly.

Cross-connections, east and west, have not been neglected. In the vicinity of San Jose, we find not only the aforementioned State Sign Route 17 but funds have also been budgeted for the first unit of the Stevens Creek Freeway in Sunnyvale and Route 113 is being developed to high standards in Mountain View. Northerly in San Mateo County, funds have been budgeted for a controlled-access artery in Redwood City on Legislative Route 214 and the first unit of the 19th Avenue Freeway connecting Half Moon Bay with the San Mateo-Hayward Bridge is nearing completion. A route has also been adopted in San Bruno between the Bayshore Freeway and Sweeney Ridge near Skyline Boulevard.

Four Major Projects

In the north, U.S. 101 is being developed to freeway standards with four major projects presently under construction, bringing closer the day when this route will be full freeway throughout both Marin and Sonoma Counties. State Sign Route 37 has been completed to expressway standards easterly to Sears Point and Sign Route 17 is a full freeway between the San Rafael-Richmond Bridge and the Redwood Highway. Construction is also under way on the State Sign Route 12 freeway between east of Sebastopol and Santa Rosa in Sonoma County and this entire route easterly to the Napa county line has been adopted as a freeway.

In Napa County there have also been considerable improvements to the highway system. Portions of Sign Route 29, south of Napa to Vallejo, were developed to expressway standards to handle heavy wartime traffic and this same type of stage construction is being used at the present time north of Napa. A portion of the freeway on this route has been completed in the westerly part of Napa.



U.S. 101 north of Santa Rosa near the offramp to Windsor where the new freeway section intersects the existing Redwood Highway.

In the East Bay, the Nimitz Freeway has been completed and in service for several years connecting Oakland and San Jose. Projects are presently under construction or planned to continue to improve this heavily traveled north-south artery. Radiating easterly from Nimitz is the recently improved Jackson Street widening on Route 105 and the four-lane freeway on Route 228 that for several years has connected Nimitz to U.S. 50. A third major east-west connection is the portion of Interstate Route 680 which is presently under construction between Mission Boulevard and Scott's Corner. U.S. 50 has been in service for several years as a combination freeway and expressway between Hayward and the San Joaquin County line.

Freeways in Oakland

Within the City of Oakland, approximately four miles of MacArthur Freeway, an eight-lane interstate facility, have been opened to traffic and construction is underway on this route southerly to San Leandro. Along the eastern foothills of Oakland, Warren Freeway has been completed throughout most of its length. North of Oakland, U.S. 40 has been completed as a full freeway, constructed to interstate standards, to the Carquinez Bridge.

In Contra Costa County, the last unit of State Sign Route 24 between the Caldecott Tunnel and Walnut Creek is underway and an additional bore is being made at the Caldecott Tunnel. State Sign Route 21 (Interstate 680) has been developed to full freeway for the majority of its length north of Walnut Creek and the present gap is currently under construction. South of that city, approximately seven miles of this route is being built.

This, then, is a quick sketch of the freeway and expressway system as it begins to take shape in 1963. When viewed against the background of growth and development of the Bay area in the past two decades, the improvements listed below become a significant part of that growth.

ALAMEDA COUNTY

One of the more significant improvements in Alameda County during the past year was the opening of the Webster Street Tube to traffic on February 13, 1963. But other developments of equal importance were the completion of four contracts on the MacArthur Freeway, continued improvement of the Warren and Nimitz Freeways and of State Sign Route 24 between Oakland and the suburban communities to the east and the beginning of construction on Interstate 680 east of Mission San Jose.

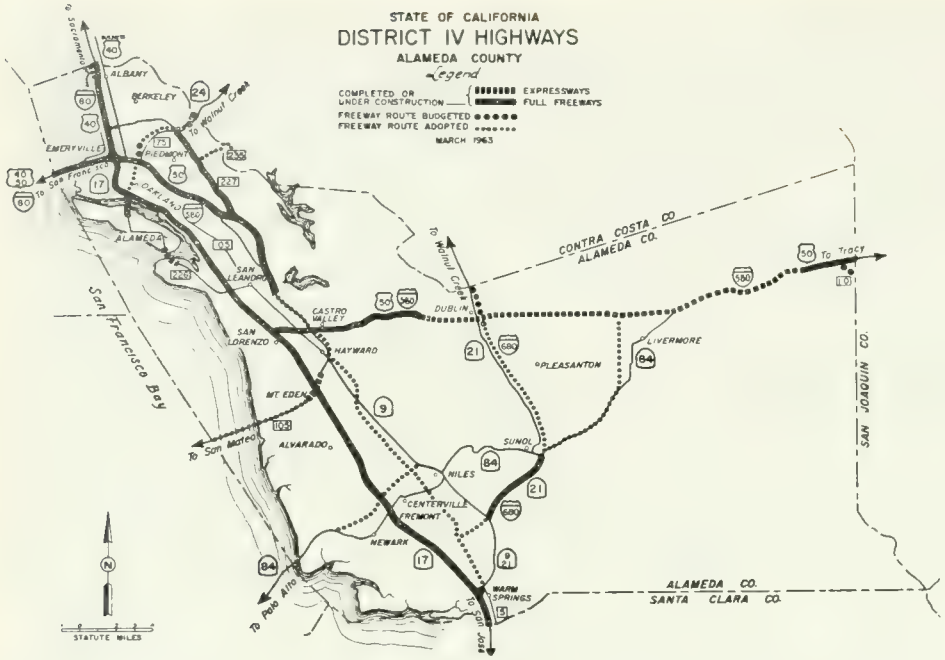
In addition to the above work, landscaping was planted and median barrier installed on completed portions of U.S. 40 and State Sign Route 17. Jackson Street (Route 105) was widened to a divided four-lane conventional street in the City of Hayward. Numerous other projects were completed or are currently underway throughout the county, including three additional contracts on MacArthur Freeway which will complete this facility through the City of Oakland.

Funds have been included in the 1963-64 fiscal year budget for additional freeway construction on Interstate 680 (State Sign Route 21), State Sign Route 24 and the Grove-Shafter Freeway. Landscaping projects on Warren and MacArthur Freeways are also budgeted.

MacArthur Freeway (Interstate 580)

Formerly known as Interstate 5W, this facility has been redesignated as Interstate 580.

Approximately 3.8 miles of continuous eight-lane interstate freeway



is in service between the Bay Bridge distribution structure and Park Boulevard in Oakland. Three contracts, from the distribution structure to Grand Avenue, were opened simultaneously on May 15, 1962 and the remaining portion was completed on November 30, 1962.

A total of 18 overcrossings and undercrossings for the freeway and ramps were included in the first three contracts which cost approximately $11,600,000. Interchanges were constructed at existing MacArthur Boulevard, Oakland Avenue-Harrison Street and at Grand Avenue. Construction also included the substructures for the future MacArthur-Grove Shafter Freeway Separation. C. K. Moseman and Son, Guy F. Atkinson, and Peter Kiewit Sons Company, respectively, were the contractors on these projects.

The contract between Grand Avenue and Park Boulevard cost approximately $4,392,000 and was constructed by Peter Kiewit Sons Company. Six bridges were constructed on the project. One of them, the separation constructed over Park Boulevard, will not be placed in service until the freeway contracts presently underway to the east have been completed and opened to traffic.

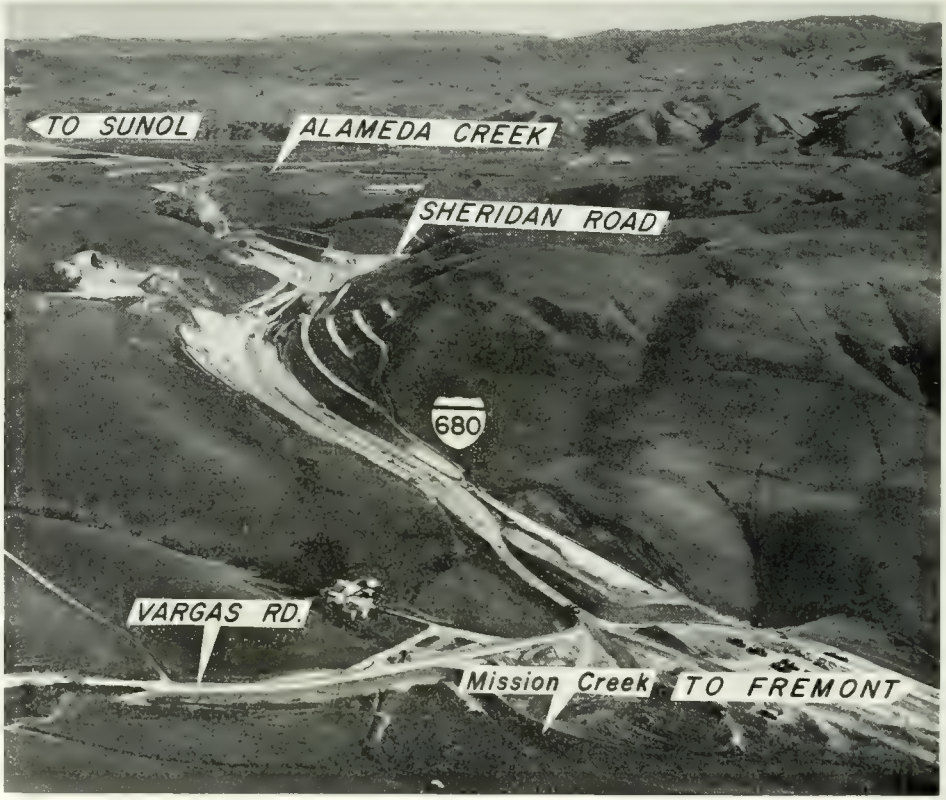
Interchanges were constructed at Park Boulevard and in the Grand Avenue-Lakeshore area. Eleven retaining walls were built throughout the project to minimize the right-of-way requirements through the sidehill terrain which the freeway traverses.

Units Under Construction

Construction is underway on three major projects between Park Boulevard and Sybil Avenue in San Leandro. More than $24,600,000 has been allotted for these contracts which involve the construction of eight lanes of freeway for a distance of approximately 11 miles.

The first of these contracts, between Park Boulevard and Buell Street, is being performed as a joint venture by Stolte, Inc. and Morrison-Knudsen Company Inc. Interchanges are being constructed at Bruce Street, Fruitvale and Coolidge Avenues, 35th Avenue, High Street and at MacArthur Boulevard near Mills College. In addition, a pedestrian separation is being built in the vicinity of Redding Street, and 19 retaining walls are required to minimize right-of-way requirements. Overcrossing structures at 13th, Ardley, Sheffield, 35th and 38th Avenues have been completed and opened to local traffic. This project is expected to be completed in early 1964.

The second project, which extends from Buell Street to the east city limits of Oakland near Durant Avenue, is on new alignment superimposed upon Calaveras Avenue and a portion of Mountain Boulevard. A sum of $11,-



Construction operations on Interstate 680 viewed northeasterly through the Mission Pass area along the former alignment of State Sign Route 21. Vargas Road interchange in the foreground.

920,000 has been allotted for this 4.5-mile contract which is being constructed by Gordon H. Ball, Inc. Interchanges will be constructed at Edwards, Kuhne, Keller and 106th Avenues and at Golf Links Road (98th Avenue). In addition, a full directional interchange will be constructed at Calaveras Avenue to provide connections to the Warren Freeway; and rough grading for a portion of the Warren Freeway is being performed.

South of the above project, 1.9 miles of freeway is being constructed by Guy F. Atkinson between Durant Avenue in Oakland and Sybil Avenue in San Leandro. The major interchange on this unit will be at the intersection with existing MacArthur-Foothill Boulevard at the northerly end of the project. Seven undercrossings will be built for city streets and ramps in addition to two bridges to be constructed over San Leandro Creek and the Grand Avenue Overcrossing.

Landscaping Projects

Bids were opened on March 27, 1963 for a contract to landscape 2.3 miles of the completed section of MacArthur Freeway between Hannah Street and 0.3 miles west of Grand Avenue. $170,000 has been budgeted for this work which includes the planting of over 950 trees, 10,400 shrubs and 20,300 ice plant and ivy for ground cover.

Funds in the amount of $195,000 have been budgeted for landscaping 1.5 miles of MacArthur between Grand Avenue and Park Boulevard and this project should be advertised in the near future. A sum of $360,000 has been included in the 1963-64 budget for landscaping the 2.6-mile portion between Park Boulevard and Buell Street when that portion of the freeway has been completed.

U.S. 40 (Interstate 80)

A contract for five miles of median barrier, consisting of both cable chain link and blocked-out metal beam guard rail, between El Cerrito Overhead and San Pablo Dam Road was completed in May of 1962. This contract cost approximately $89,000. Within the same area, a $191,500 landscaping project, between 0.3 mile south of the overhead and 0.3 mile south of Jefferson Avenue was completed in March of 1962.



Recently completed widening of Jackson Street (State Highway Route 105) in Hayward between the Nimitz Freeway and Mission Boulevard. Southern Pacific Railroad underpass in foreground.

A contract to widen the Oakland approaches to the San Francisco-Oakland Bay Bridge is expected to be completed in the near future. Improvements to the toll gates on the north side of the plaza are included in this $380,000 project.

Nimitz Freeway

Two projects were completed on Nimitz Freeway, (State Sign Route 17) in the fall of 1962. Cable chain link median barrier was installed between Jackson Street (Route 105) and Washington Avenue (Route 288). This contract, which cost approximately $72,800, was completed in October. A month earlier, Watkin & Sibbald completed an irrigation system and landscaping on 2.3 miles of freeway between 0.7 mile south of Central Avenue in Fremont and 1.1 miles north of Thornton Avenue in Newark. The cost was $87,200.

Currently under construction is the 5.6-mile widening contract between Fallon Street and Hegenberger Road in Oakland which, when complete, will provide 8 lanes on Nimitz Freeway between El Cerrito Overhead and Hegenberger Road. The work includes widening the High Street, Fruitvale and 5th Avenue Overheads and modification of interchange ramps at Hegenberger Road, High Street, 29th Avenue and 23d Avenue. The former left hand offramp at 42d Avenue is being replaced with a right side takeoff. Work on this $4,441,000 contract is being performed as a joint venture by Dan Caputo, Dan Caputo Company and Cambrian Gateway.

Blocked-out metal beam guard rail is being erected as a median barrier as a part of the contract.

In San Leandro, a $512,000 contract is being performed by Richard N. Moseman at Marina Boulevard (First Avenue) Interchange. Two diagonal ramps are being constructed and the existing two-lane overcrossing is being widened to four lanes. This work is expected to be completed this summer.

Warren Freeway (Route 227)

Construction is currently in progress on a $1,292,000 contract to construct an interchange at Moraga Avenue, which will replace the last signalized interchange on Warren Freeway north of Redwood Road. The contractor on this project is Dan Caputo Company. Funds in the amount of $45,000 are included in the 1963-64 budget for landscaping this interchange.

The rough grading for the Warren Freeway between Carson Street and the MacArthur Freeway near Calaveras Street is included in the latter freeway contract currently underway between Buell Street and Durant Avenue.

Sign Route 24

Funds in the amount of $3,750,000 have been included in the 1963-64 fiscal year budget for construction of portions of this route between Lake Temescal and the Caldecott Tunnel. This work will complete a sizeable portion of the grading for the future eight-lane freeway through the rugged canyons of the Berkeley Hills. Included in the project is a partial interchange approximately one-half mile east of Lake Temescal and a signalized intersection on Tunnel Road (Route 206), one-half mile north of Temescal. Easterly of this project, the current contract for the additional bore at the Caldecott Tunnel is underway. *(See Contra Costa County).*



Construction progress on Interstate 580 (MacArthur Freeway) viewed easterly from Maple Avenue towards Calaveras Avenue.

Grove-Shafter Freeway

The 1963-64 budget includes funds in the amount of $6,235,000 to construct the interchange connectors between the MacArthur and Grove-Shafter Freeways. Design studies on this project and for the remaining portions of the route between the MacArthur Freeway and east of Lake Temescal are underway but final preparation of plans will be delayed pending the determination of engineering and right-of-way requirements for rapid transit facilities adjacent to the freeway.

Webster Street Tube

The first step to relieve traffic congestion between the island City of Alameda and Oakland across the Oakland estuary was completed on February 13, 1963 with the opening of the new Webster Street Tube described in the March-April issue of *California Highways and Public Works.*

This $17,000,000 facility required approximately 3½ years to construct and, including approaches, is 5,923 feet long. It was constructed by sinking precast tunnel segments in a dredged trench, aligning them accurately and connecting them underwater. This is the 12th underwater tube completed by this method, the adjacent Posey Tube having been the first. The contractor on this work was Pomeroy-Bates and Rogers & Gerwick.

For the next few months, the new tube will carry two-way traffic while the Posey Tube undergoes extensive modernization including interior tiling, improved ventilation equipment and fluorescent lighting. Funds in the amount of $1,100,000 are allotted for these alterations. Upon the return of the Posey Tube to service, 35 years of single-tube operation between Oakland and the City of Alameda will be ended.

In June 1962, a sum of $149,200 was expended to provide a protective blanket over the existing Posey Tube. The dredging and backfilling on this

contract was performed by Healy Tibbitts Construction.

Sign Route 21

Six and one-tenth miles of four-lane (ultimate six-lane) freeway is under construction on Sign Route 21 (Interstate 680) between State Sign Route 9 near Mission San Jose and State Sign Route 84 at Scott's Corner. This contract has required the closing of the Old Mission Pass Road and through traffic is being detoured over Niles Canyon Road. Interchanges and traffic separation structures will be constructed at Mission Boulevard and Vargas, Sheridan, Andrade and Calaveras Roads on this $6,200,000 project. Major structures will also be constructed over Alameda Creek. This work is being performed as a joint venture by Frederick & Watson Construction Company, Granite Construction Company, and Lew Jones Construction.

The 1963-64 fiscal year budget contains funds in the amount of $7,500,000 for the construction of three miles of six-lane freeway between south of Dublin and 0.7 miles north of the Contra Costa County line. This project will include a major interchange between Interstate Routes 580 and 680.

State Route 105

The contract for the widening of 1.7 miles of Jackson Street between Harder Road and Mission Boulevard in Hayward was completed on March 11, 1963. This $2,143,000 project included overheads at the Southern and Western Pacific railroads. Jackson Street was widened to a four-lane divided arterial with parking lanes. This work was done by Gallagher and Burke.

The City of Hayward contributed $74,400 and the Southern Pacific railroad $73,400 to assist in the financing.

Other Projects

Many other projects were completed on State Sign Routes 9 and 84 in Alameda County during the past year. These included a $71,500 contract for realigning curves and eliminating humps on seven-tenths miles of Vallecitos Road (State Sign Route 84) between Alden Lane and El Caminito near Livermore. This project was completed in July of 1962 by Oliver de Silva Inc.

The remainder consisted of the installation of traffic signals and channelizations as well as resurfacing on the Dumbarton Bridge. $13,400 of San Francisco-Oakland Bay Bridge funds were used for the latter contract. Traffic signals were also installed at five locations along Mission Boulevard (Route 105) in Hayward during the past year.

CONTRA COSTA COUNTY

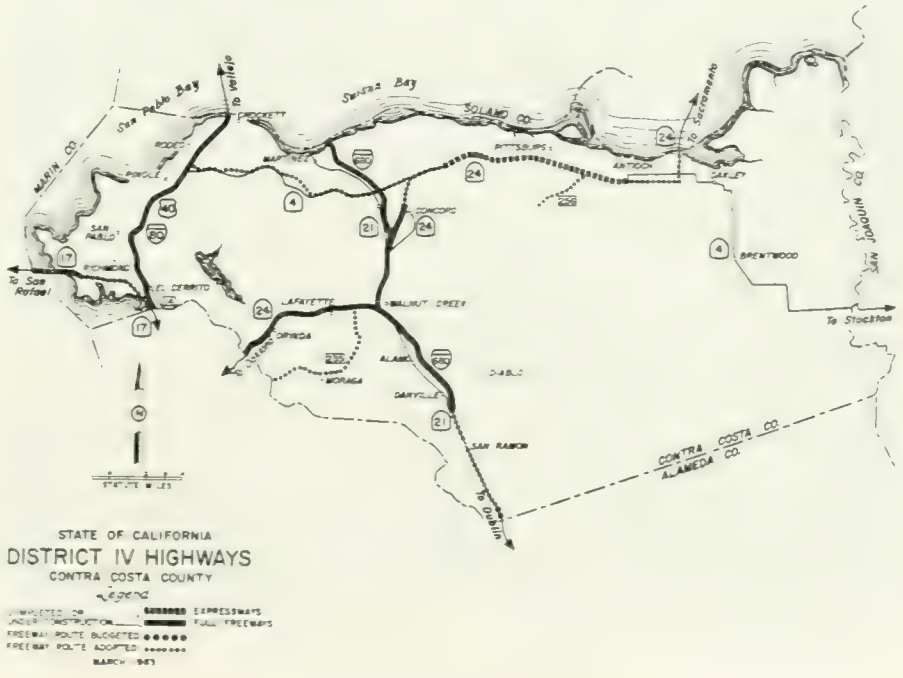
The completion of the Benicia-Martinez Bridge on September 15, 1962, and the subsequent opening of approximately eight miles of freeway southerly to Willow Pass Road were major steps in the development of the freeway and expressway system in Contra Costa County during the past year. Continued emphasis has been placed upon the improvement of Interstate 680 (State Sign Route 21) north and south of Walnut Creek and the completion of Sign Route 24 between the metropolitan communities and the rapidly expanding suburban areas east of the Berkeley hills. Two projects on these routes, currently under construction, will provide approximately 30 miles of continuous freeway from Caldecott Tunnel to U.S. 40 north of Vallejo via the Benicia-Martinez Bridge.

Sign Route 21

South of Walnut Creek, the largest freeway contract ever let in the Bay area is underway—$13,750,000 for the construction of 6¾ miles of four-lane freeway on Sign Route 21 (Interstate 680) between Walnut Creek and one mile south of Danville, replacing the present congested two-lane highway.

This project includes almost 6,000,000 cubic yards of excavation, the majority of which will be used to construct embankment within the contract limits. An excess of 400,000 yards is being used for bridge approaches and embankment on a contract currently underway on Sign Routes 21 and 24 in the vicinity of Concord.

A total of 13 major structures are to be completed, including four separate bridges over San Ramon Creek and an overhead over the Southern Pacific railroad, plus seven interchanges. Contra Costa County will contribute approximately $343,000 towards the cost of county road construction and local drainage improve-



ments which include realigning 12,000 feet of San Ramon Creek in seven locations. Guy F. Atkinson is the contractor on the project.

In the vicinity of Concord, a portion of Sign Route 21 is included in the construction currently in progress on State Sign Route 24 between 0.2 mile south of Monument Boulevard and 0.1 mile south of Olivera Road. Gordon H. Ball, Gordon H. Ball Inc., and Price & Harris Construction Company are the contractors on this $5,480,000 joint venture. This project will close the gap on Interstate 680 between Monument Boulevard and Willow Pass Road.

Interchanges are being constructed at Monument Boulevard on the combined routes and at Concord Avenue, Grant Street and Willow Pass Road on Route 24. Five undercrossings as well as structures over Walnut and Pine Creeks and an overhead over the Southern Pacific railroad near Concord Avenue will be constructed. A "Y" interchange will be constructed at the intersection of the two routes.

Completed Projects

North of the above project, work was completed on January 8, 1963, on a portion of Interstate 680 between Willow Pass Road and State Sign Route 4 (Arnold Industrial Highway). Four interchanges were constructed on this $3,984,000 contract. This project provides 2.3 miles of freeway on State Sign Route 21 and approximately 1.2 miles of freeway on Highway 4. In addition to those at the interchanges, structures were built on both routes across Grayson Creek and at Center Street. The contract was performed as a joint venture by Gordon H. Ball and Gordon H. Ball Inc.

Between Arnold Industrial Highway (Sign Route 4) and the Benicia-Martinez Bridge, 3.9 miles of initial four-lane, future six-lane freeway was completed by Peter Kewitt Sons Company in September of 1962. This $5,131,000 contract was financed from toll bridge revenue bonds. Overcrossing structures were completed at Blum Road and East Martinez interchange. An underpass was constructed at the Santa Fe railroad in East Martinez and an overhead structure was provided in the Mococo cloverleaf interchange over Escobar Street and the Southern Pacific railroad. An interchange was built at Arthur Road at the approach to the bridge.

Benicia-Martinez Bridge

Two separate contracts, one for substructure and another for superstructure construction, were required to complete this 4,500-foot-long high-level bridge. Revenue bond funds in the amount of $14,238,000 were allocated to these contracts, which were both performed by Yuba Consolidated Industries, Inc.

The new bridge, about 200 feet downstream from the Southern Pacific railroad drawbridge across Carquinez Straits, was started in August of 1959. It provides an initial four-lane, future divided six-lane facility and toll collecting facilities are located on the Benicia side of the Straits. Upon the opening of the bridge to traffic, the last automobile ferry boat in the Bay area was retired from service.

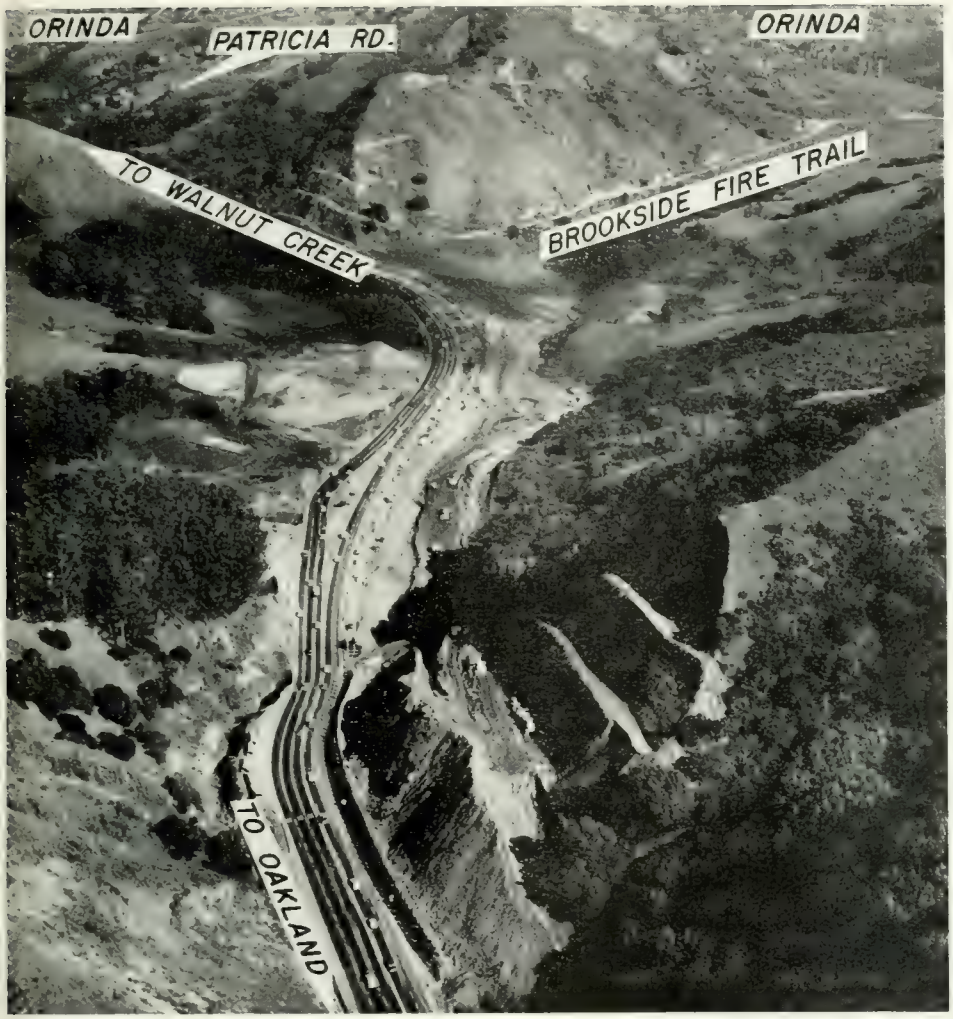
(An article in the Sept.-Oct. 1962 issue of *California Highways and Public Works* describes the opening of the bridge to traffic on September 15, 1962.

Sign Route 24

A 0.7-mile contract for the construction of an additional two-lane bore, paralleling the two existing bores of the Caldecott Tunnel, is being constructed as a joint venture by Connelly Pacific Company, Grafe-Callahan Construction, Brayer Electric Company and Charles Harney Inc.



Looking southerly from vicinity of Arthur Road to recently completed section of Interstate 680 between Willow Pass Road and Benicia-Martinez Toll Bridge.



Benching operations for the future eight-lane freeway on State Sign Route 24 in the rugged Berkeley Hills east of the Caldecott Tunnel.

This $10,897,000 project will provide a 28-foot roadway and 4-foot sidewalk within the 3,371-foot tunnel. When completed, the new bore will carry westbound traffic and the southerly existing tunnel will carry eastbound traffic with the center bore being used to provide an additional two lanes one-way in the direction of peak hour flow.

From the east end of the tunnel toward Orinda, work is in progress on the construction of approximately two miles of eight-lane freeway. Approximately 1,800,000 cubic yards of roadway excavation is being removed from sidehill cuts which are several hundred feet high on this $6,974,000 project. Another feature of this work is the installation of an extensive drainage system to carry the runoff from the entire watershed at the end of the tunnel to Orinda, a distance of two miles.

Interchanges will be constructed at East Portal and at Gateway Boulevard (formerly Sanborn Road). The project includes the installation of median barrier. Frederick & Watson Construction Company and Granite Construction Company are the contractors on this joint venture.

Bids were opened on May 1, 1963, for the construction of bus-loading facilities and sidewalks at Orinda, Acalanes Road and Pleasant Hills Road interchanges.

North of Walnut Creek, Sign Route 24 is being extended as a full freeway between Monument Boulevard and Olvera Road.

Other Routes

A contract for approximately five miles of median barrier, consisting of both cable chain link and blocked-out metal beam guard rail, between El Cerrito Overhead and San Pablo Dam Road on U.S. 40 (Interstate 80) was completed in May of 1962 at a cost of $89,000. Funds are budgeted for a $420,000 project for the construction of the Barrett Avenue offramp in Richmond on this same route.

MARIN COUNTY

Two major projects currently being constructed at the intersection with State Sign Route 37 in the vicinity of Ignacio and near Hamilton Air Force Base will alleviate considerable traffic congestion on the Redwood Highway (U.S. 101). Other improvements were completed or have been budgeted to provide safer traffic service on this heavily traveled thoroughfare. Landscaping projects, including the one at the Vista Point for the Golden Gate Bridge, were also completed during the past year.

U.S. 101 (Redwood Highway)

North of Hamilton Field, construction has begun on the interchange between State Sign Route 37 and U.S. 101. When completed, this interchange will eliminate the major point of traffic backup for commute traffic and summer Sunday traffic returning from Sacramento, the Russian River area and Lake County resorts. Funds in the amount of $4,278,000 have been allotted for this project which includes the construction of the Ignacio Overcrossing, the South Novato Overcrossing and multiple overheads over the Northwestern Pacific railroad tracks. Peter Kiewit and Sons is the contractor on this work.

Immediately south of this project, work is underway on the construction of 2.7 miles of six-lane freeway between Miller Creek Road and Entrada Drive. $4,241,000 was allotted for this project which includes climbing lanes in both directions over St. Vincent's Hill north of Miller Creek Road. In addition, a bridge is to be widened and two interchanges are to

be constructed. Traffic to and from Hamilton Air Force Base will be served by a frontage road between the two interchanges. Syar & Harms and Gordon H. Ball, Gordon H. Ball Inc. are the contractors on this joint venture.

The completion of these two projects will eliminate the last remaining signals on U.S. 101 between the Golden Gate Bridge and Diablo Avenue in Novato.

Funds in the amount of $300,000 have been budgeted for a project to restripe to four lanes and resurface uphill portions of U.S. 101 between the Golden Gate Bridge and Waldo Undercrossing. A sum of $100,000 has been included in the 1963-64 fiscal year budget for landscaping Freitas Parkway Interchange (Terra Linda) north of San Rafael.



Completed Projects

In August of 1962, a contract to modify the Golden Gate Bridge approaches to meet structure widening being done by the bridge district was completed by Ghilotte Bros. $225,000 was expended for constructing lane transitions, installation of blocked-out metal beam median barrier between the bridge and the Waldo Tunnel, adding a northbound lane from the Vista Point to the Sausalito Road Undercrossing and an improved Sausalito Road channelization.

At the Vista Point at the north end of the bridge, $162,000 was expended on a project which included grading and surfacing of access roads and parking areas, the construction of walkways and planter boxes and landscaping. A combination rubble masonry and redwood guard railing was constructed on the perimeter of the sidewalk around the parking area. This contract was done by Watkin and Sibbald.

In the vicinity of San Rafael, $116,000 was expended on the reconstruction of the Auburn Street Railroad Underpass in the San Quentin Wye area. This contract included rearranging a portion of the interchange frontage roads and the extension of Woodland Avenue under co-operative financing with the County of Marin. North of San Rafael, an additional northbound lane was added between Lincoln Avenue Undercrossing and San Pedro Road, at a cost of $36,000. Blocked-out metal beam median barrier was recently installed from the San Rafael Viaduct northerly to Willow Avenue, almost two miles, costing $106,000.



Looking southerly to the recently completed Vista Point and reconstruction at the north end of the Golden Gate Bridge. The City of San Francisco in the background.

A contract to landscape portions of the Redwood Highway between the Waldo Undercrossing and Miller Creek Road north of San Rafael was completed on March 6, 1963.

Additional Routes

Work is currently in progress for the construction of a four-lane divided conventional highway between Alto Interchange and east of Strawberry Drive on Legislative Route 52. Included in this $618,000 project is the installation of traffic signals.

Two separate contracts were completed on State Sign Route 1 between Stinson Beach and Bolinas. The first, completed in July, 1962, cost $137,692 for resurfacing and installing drainage facilities. In December, a $90,700 contract for realigning portions of the route was completed. The latter contract also included drainage installations and slope protection. Brown Ely Company was the contractor on the above three projects.

NAPA COUNTY

Generally, major highway development in recent years within Napa County has been confined to initial stage construction of two- and four-lane expressways on adopted freeway routes in the vicinity of Napa. This steady improvement to modern highway standards is being continued by construction presently in progress on State Sign Route 29. In addition, contracts were completed during the past year for the improvement of conventional highways on State Routes 37 and 128.

Freeway Construction

A contract was recently awarded to Lee J. Immel for the construction of a 2.2-mile section of Sign Route 29 between Old Sonoma Road and Redwood Road (Trancas Street). This project includes construction of a four-lane freeway from Old Sonoma Road to Napa Creek and resurfacing of the existing pavement between Napa Creek and Redwood Road.

Approximately 860 trees are being planted on a landscaping project on the recently completed freeway section between Imola Avenue and Old Sonoma Road.

Other Work

South of Napa, a contract to resurface 2.6 miles of the southbound lanes between Imola Avenue and Kelley Road was completed in June of 1962. Approximately $104,000 was expended for this work. Northwest of Napa, a $626,500 contract is in progress for the widening of the roadway between south of Yountville Road and Oakville. As a part of this contract, frontage roads and drainage improvements are being constructed between Dry Creek and California Drive. This work by Lee J. Immel is expected to be completed this summer.





The first unit of the Napa Freeway was completed recently. Another project is about to be awarded to extend this freeway another mile north, toward Calistoga.

A third contract for the improvement of Sign Route 29 over Mt. St. Helena was completed in July of 1962. This $56,000 project provided three truck turnouts between Calistoga and the Lake county line.

Other Improvements

Present programing proposes the utilization of $50,000 every other year for reconstruction of portions of State Sign Route 128 between Pope Valley Road and the Monticello Dam Road relocation. The third segment of such reconstruction was completed in December of last year.

East of Napa, the contract for the construction of a 26-foot all-paved section at several locations on existing State Sign Route 37 between Wooden Valley Road and Sign Route 128 was completed on January 31, 1963. This work cost approximately $152,800 and was constructed by Reichhold & Jurkovich. In order to avoid an area in which repeated slip-outs have occurred, 0.2 mile of Sign Route 37 was realigned approximately 21 miles northeast of Napa, at a cost of approximately $38,000.

SAN FRANCISCO COUNTY

Three contracts are currently underway for the completion of the Southern Freeway within the City and County of San Francisco. In addition, funds have been budgeted for the first unit of the Junipero Serra Freeway (Interstate 280) in Daly City which will include a connection to the Southern Freeway in the vicinity of Orizaba Avenue. Work has also been started on the first unit of the Southern-Embarcadero Extension Freeway and funds are budgeted for an additional section.

Southern Freeway

The first usable project on the Southern Freeway, between Milton Street and the interchange with the James Lick (Bayshore) Freeway is expected to be opened to traffic late this year. The $4,273,000 project is being constructed by Charles L. Harney, Inc., as are the other two units currently under construction. When completed it will provide 4.7 miles of six-lane (ultimate eight-lane) freeway. Two major overcrossing structures serving local traffic to and from Alemany Boulevard are included, as well as overcrossings for Mission Street, Justin Drive and a pedestrian bridge near Gladstone Drive.

The second contract consists of grading and paving for a six-lane freeway, constructing 13 traffic separations, pedestrian crossings and interchange structures and 9 retaining walls. Overcrossings are being constructed at Paulding Street and Baden Street and pedestrian overcrossings will be provided at Theresa Street and Lamartine Street. The remaining nine structures will be overcrossings and undercrossings in the vicinity of San Jose Avenue, to furnish traffic service to San Jose Avenue, Monterey Boulevard, Bosworth Street and Lyell Street. A sum of $6,080,000 has been allotted for this contract.

The above project will not be usable for traffic until the third unit between Ocean Avenue and Orizaba Avenue has been completed, in the summer of 1964. Interchange facilities will be constructed at Ocean Avenue and ramps will be provided for traffic to and from San Jose Avenue in the vicinity of Plymouth Avenue on this $4,581,000 project. Major structures include overcrossings for San Jose Avenue in the vicinity of Broad Street and Mount Vernon, Geneva and Ocean Avenues. Overcrossing structures will be constructed for the freeway and ramps at San Jose Avenue and Sickles Avenue, and pedestrian overcrossings are being provided at Whipple Avenue and Havelock Street.

Also included in the work is construction of bus stop facilities at Ocean Avenue to permit passengers from express buses on the freeway to transfer to local buses on Geneva and Ocean Avenues.

As each construction phase on the Southern Freeway is completed, it is planned to landscape that project. Funds in the amount of $110,000 have been included in the 1963-64 budget for one of these projects to landscape

the first section between Alemany Interchange and Milton Street.

Funds in the amount of $10,000,000 have been included in the 1963-64 budget for a project which combines the completion of the Southern Freeway with the beginning of the Junipero Serra Freeway (Interstate 280) in San Mateo County. (For a discussion of this project, see San Mateo County.)

Embarcadero Extension

Construction is currently underway on the construction of the double-deck viaduct between James Lick Memorial Freeway and Newcomb Avenue. This project is being constructed by Peter Kiewit Sons Co. and costs approximately $3,613,000.

It will not be usable until the second unit, from Newcomb Avenue to Army Street, is constructed. Funds in the amount of $5,580,000 have been budgeted for this work and it should be advertised this summer. The ramp connections which will be provided from Evans Avenue to Army Street, as a part of this latter unit, are an integral part of the future Islais Creek Interchange. The second unit will provide a transition from the double-deck viaduct to a single-deck viaduct.

The remainder of the route has been adopted by the California Highway Commission and when complete, this freeway will provide much needed relief to the Bayshore Freeway northerly of its interchange with the Southern Freeway.

Embarcadero Freeway

In February, J. C. Johnson was awarded a $50,000 landscaping contract for a project between First and Steuart Streets. Approximately 137 trees, mostly eucalyptus, and over 8,000 shrubs are to be planted on this job.

A project for the construction of the Clay-Washington Street ramps to the Embarcadero Freeway is tentatively scheduled for this fall. $1,350,000 has been included in the budget for this work which will provide direct access to the Golden Gate redevelopment area. Advertising is dependent on removal of the remainder

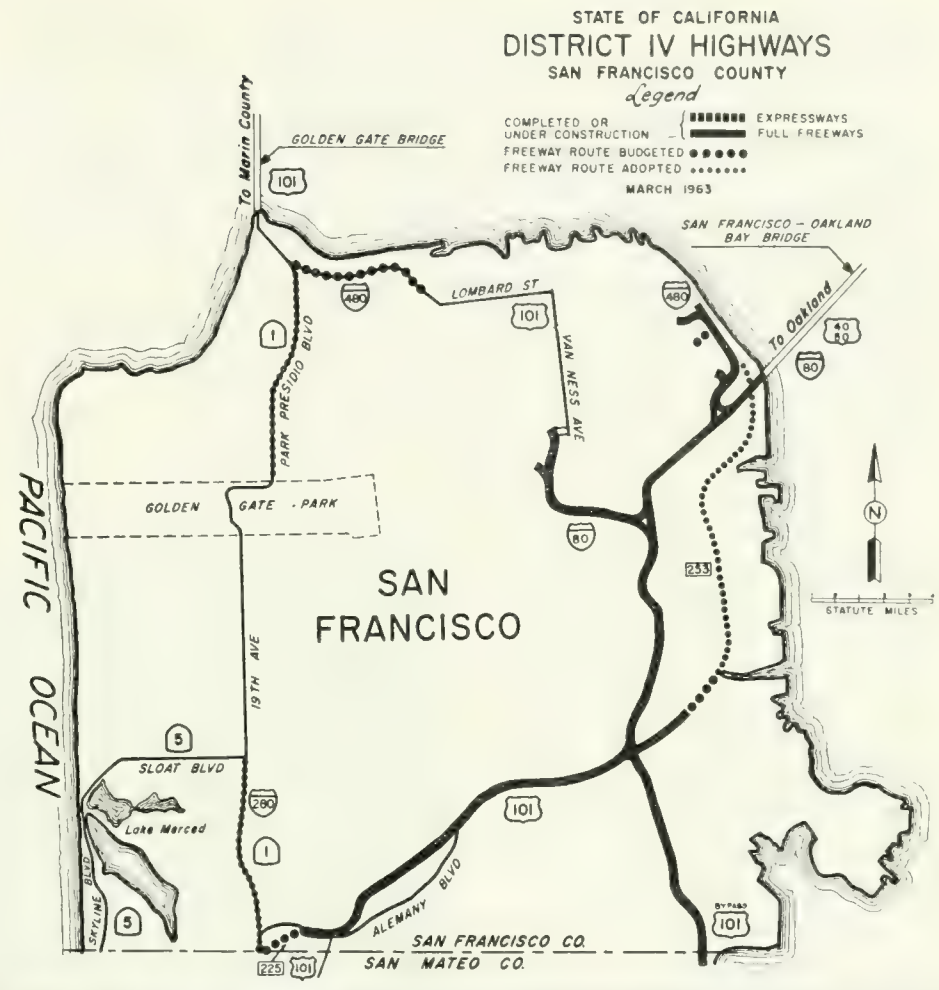




PHOTO RIGHT. Construction work on the Southern Freeway and the Southern-Embarcadero Freeway extension viewed westerly from vicinity of Alemany Boulevard. Four separate contracts are in progress.

of the Wholesale Produce Market to the new Islais Creek site.

U.S. 101 Improvements

A sum of $357,000 was expended for the resurfacing of Bayshore Freeway between 0.3 mile north of Butler Road in South San Francisco and 0.2 mile south of Third Street in San Francisco. This work was completed in November of 1962 by Pacific Pavement Company Ltd. The high volume of traffic on this route necessitated night paving and the detouring of alternate directions of traffic to old Bayshore Highway between the hours of 8 p.m. and 6 a.m.

In July of 1962, a contract for the modification of Army Street northbound offramp and the installation of sign lighting was completed at a cost of $29,000. Additional work on this facility included the installation of chain link mesh covering and railing fences on overcrossings at five locations between Silver Avenue and 18th Street.

Funds in the amount of $5,100,000 have been budgeted for the construction of additional lanes and a median on the Golden Gate Bridge approach between Lyon Street and State Sign Route 1. This project includes the revision of the interchange at Sign Route 1. Within these limits, a contract was completed in November of 1962 for cleaning and painting the Presidio Viaduct between Marina Viaduct and the approach to the Golden Gate Bridge. This work cost approximately $178,000.

SAN MATEO COUNTY

The first steps toward meeting the growing need for high-standard north-south arteries through the central, hilly portion and along the ocean coast were taken this year with the budgeting of funds for freeway projects on Junipero Serra and the Cabrillo Highway. In addition, major improvements are currently in progress on El Camino Real, as well as on the east-west connection in the City of San Mateo, the 19th Avenue Freeway.

19th Avenue Freeway

A $4,652,000 project is currently in progress as the first unit of this freeway which will eventually extend from Half Moon Bay to Hayward via the San Mateo-Hayward Bridge. Extending 2.6 miles between West Hillsdale Boulevard and South Delaware Street, this unit will provide access to the new campus of the College of San Mateo.

Four lanes are under construction between West Hillsdale Boulevard and El Camino Real while easterly of El Camino a six-lane freeway is being built. Traffic separation structures and interchanges are being built at Alameda de las Pulgas, El Camino Real (U.S. 101) and South Delaware Street. This contract also includes an overhead crossing of the Southern Pacific railroad near Pacific Boulevard and an undercrossing at Palm Avenue. L. C. Smith and Concar Ranch and Enterprises are the contractors on this joint venture.

A sum of $225,000 has been included in the 1963-64 budget for landscaping the above work when it is completed late this summer. In December the California Highway Commission adopted a portion of this route westerly of the Junipero Serra Freeway between the latter facility and State Sign Route 5 on Cahill Ridge near Mountain House.



Construction progress on the 19th Avenue Freeway in San Mateo viewed easterly from Alameda de las Pulgas.

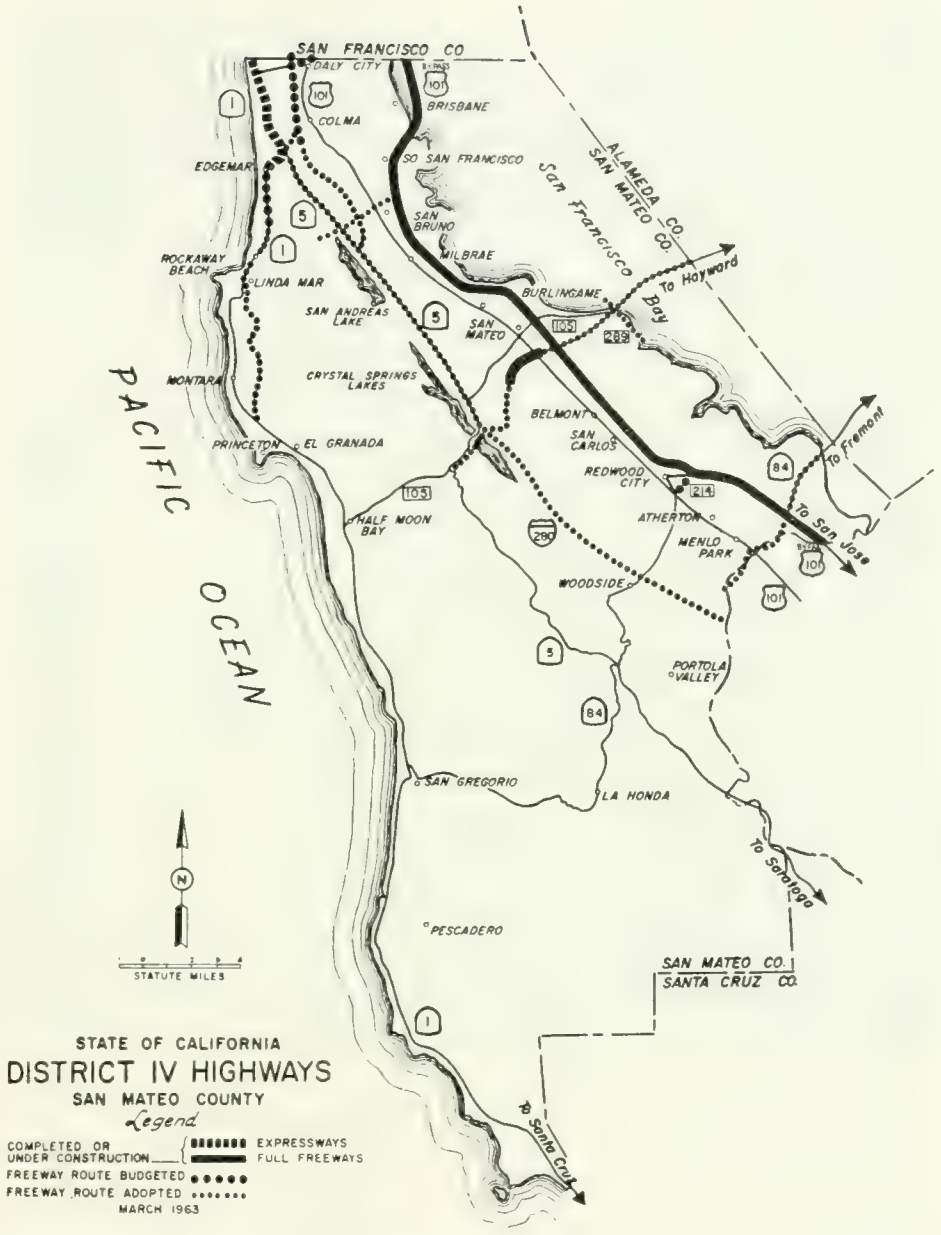
Cabrillo Highway

Along the Pacific Coast, work will shortly be underway for the improvement of two and one-half miles of the existing highway (Sign Route 1) to freeway standards. Bids were opened on May 8, 1963, for the construction of a four-lane facility between Monterey Road and Westport Drive in Pacifica. A sum of $4,055,000 has been allotted for this project which includes frontage roads through the business districts in the Edgemar and Sharp Park areas and nearly a mile of reconstruction of the existing alignment from Westport Drive southerly.

Two pedestrian crossings, four traffic separation structures are included, and a full interchange at Sharp Park Road.

North of the above project, funds in the amount of $270,000 have been budgeted for the initial construction of the Gateway Drive Undercrossing, approaches and ramps. Bids were opened on May 15, 1963, for this work. Within the same area, a contract was recently completed for the installation of 0.7 mile of blocked-out metal beam median barrier north of Monterey Boulevard. This contract by Wulfert Co. cost approximately $37,800.

In the vicinity of Half Moon Bay, drainage improvements were constructed at Virginia Avenue (Moss Beach) during the past year and $592,000 was expended to construct a new bridge across Tunitas Creek and improve the roadway approaches. Dan Caputo Company was the contractor on the latter project.



Junipero Serra Freeway

Bids will shortly be advertised for a 3.9-mile project between Palmetto Drive in San Francisco and one-half mile south of Eastmoor Avenue in Daly City on the Junipero Serra Freeway (Interstate 280). Approximately $10,000,000 has been included in the 1963-64 fiscal year budget for construction of this work. The first unit of this important interstate facility (Route 280) to be constructed in San Mateo County, the project includes rough grading, drainage and frontage road construction for the future State Sign Route 1 connection to Skyline Boulevard and Pacifica. The work will also include the completion of the Southern Freeway in San Francisco between Orizaba Avenue and the Junipero Serra Freeway.

This project includes an interchange between the two freeways in the vicinity of Alemany Boulevard and the Knowles Avenue-Alemany Boulevard Overcrossing. Four other traffic separations will be provided, and two overcrossings to carry frontage road traffic over the freeway.

Also included in the 1963-64 program is a sum of $500,000 for the construction of a bridge for the Junipero Serra Freeway over the Stanford University two-mile linear accelerator. Although this portion will not be a usable unit, construction at this time is required to maintain close co-ordination with the work in progress on various projects of the university.

El Camino Real (U.S. 101)

Work was started in January of this year on a 1.7 mile widening project on El Camino Real between Millwood Drive in Millbrae and Euclid Avenue in San Bruno. Lowrie Paving Company is the contractor on this project which will widen existing El Camino Real to a six-lane divided, conventional highway with parking aprons and sidewalks.

Funds in the amount of $821,000 are allotted for this work, including $160,000 from the City of San Bruno and $26,400 from Millbrae for the parking aprons, sidewalks and street lighting.

Bayshore Freeway

Bids were opened on March 12, 1963, for a landscaping project at the South Airport Boulevard connection to Bayshore Freeway (US 101 Bypass). Funds in the amount of $850,000 have been included in the 1963-64 budget for leveling and resurfacing portions of Bayshore Freeway between Fifth Avenue in San Mateo and Whipple Avenue in Redwood City.

A contract for $280,000 for placing cable chain link and blocked-out metal beam median barrier between Sierra Point Overhead near South San Francisco and Redwood Creek Bridge in Redwood City was completed in July of 1962. This work completed the median barrier installation on Bayshore Freeway between Redwood City and the San Francisco-Oakland Bay Bridge. Sign structures and sign lighting systems were also installed on the 17.4 mile project.

In November a $357,000 project was completed for resurfacing existing Bayshore Freeway between 0.3 mile north of Butler Road in South San Francisco and 0.2 mile south of Third Street in San Francisco (See San Francisco County).

Approximately 250 eucalyptus and flowering plum trees were planted on a landscaping project between 0.1 mile north of Spruce Avenue in Redwood City and 0.1 mile north of University Avenue in Palo Alto, a distance of 4.3 miles. Rudolph Watson was the contractor on this $84,000 project, which also included planting shrubs and iceplant cuttings for ground cover.

Other Routes

On January 23, 1963, the California Highway Commission adopted the route for the future Route 229 freeway between Sweeney Ridge, west of Skyline Boulevard, and Bayshore Freeway, an important east-west connection in the City of San Bruno.

Funds in the amount of $1,250,000 have been budgeted for the construction of 1.3 miles of four-lane expressway on Legislative Route 214 in Redwood City between Cypress Avenue, south of El Camino Real, and Bayshore Freeway. This project will include a railroad separation across the main lines of the Southern Pacific Railroad and a full interchange at El Camino Real. Access will be controlled between Middlefield Road and Broadway. The City of Redwood City is contributing approximately $1,000,000 additional for this work.

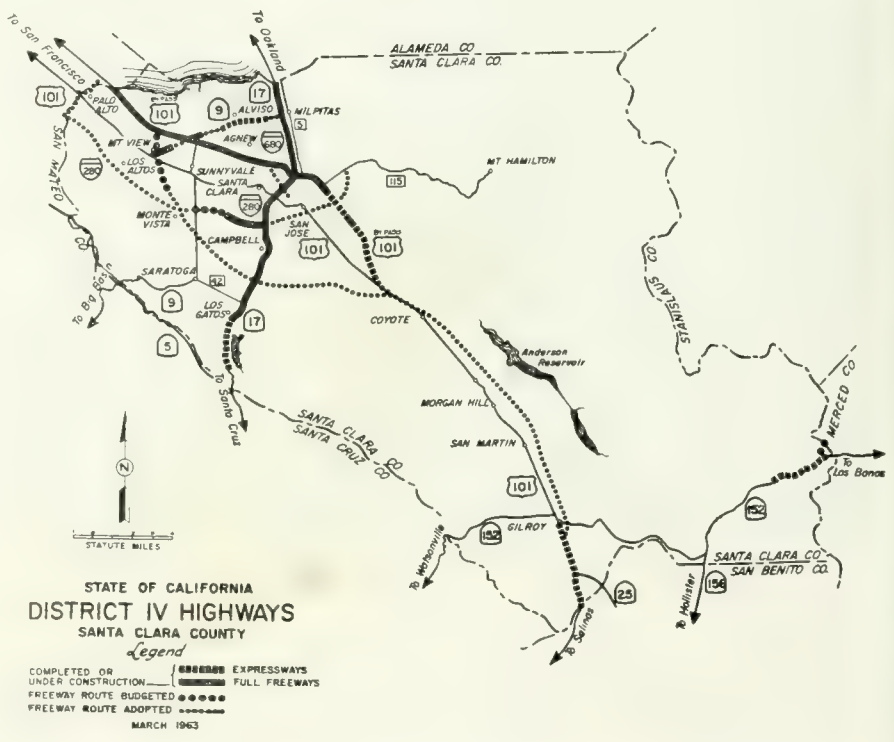
Work was completed in August of 1962 on the Division of Highways portion of the development of Thornton Beach State Park by the Division of Beaches and Parks. A total of $119,000 was expended for this improvement, the highway allotment being $25,000. The highway project consisted of constructing a two-lane access road, parking areas and a water and sewer system for this newly established metropolitan recreational area for picnicking, fishing, hiking and beach sport. The access road utilizes a large portion of relinquished State Sign Route 1.

SANTA CLARA COUNTY

With the completion of Bayshore Freeway in 1962 to full freeway standards between San Francisco and San Jose, the emphasis on highway development in rapidly growing Santa Clara County has turned to construction of the Junipero Serra and Stevens Creek Freeways. Two separate contracts are underway on the former and projects on each have been included in the 1963-64 budget. Other contracts were completed, are under construction or are budgeted on U.S. 101, State Sign Route 9, El Camino Real and Highway Route 113.

Junipero Serra Freeway

Work is expected to be completed by the end of this year on the first unit of Interstate 280. This project is 4.3 miles in length, extending from Forest Avenue to Doyle Avenue at Stevens Creek Boulevard in San Jose. Funds in the amount of $4,754,000 are



allotted for this work which is being done by Gibbons & Reed Co. and Dan Caputo Co. The work includes the addition of lanes on the inside of State Sign Route 17 between Moorpark Avenue and Forest Avenue.

The existing Stevens Creek Boulevard Interchange is being modified to accommodate collector roads and direct connection ramps to Junipero Serra Freeway. This unit will be usable to Saratoga Avenue, with grading only being done westerly of that point to Stevens Creek Road in the vicinity of Doyle Avenue. Interchanges are being constructed at Santa Clara-Los Gatos Road and at Saratoga Avenue. Two pumping plants and two pedestrian separations are also being built.

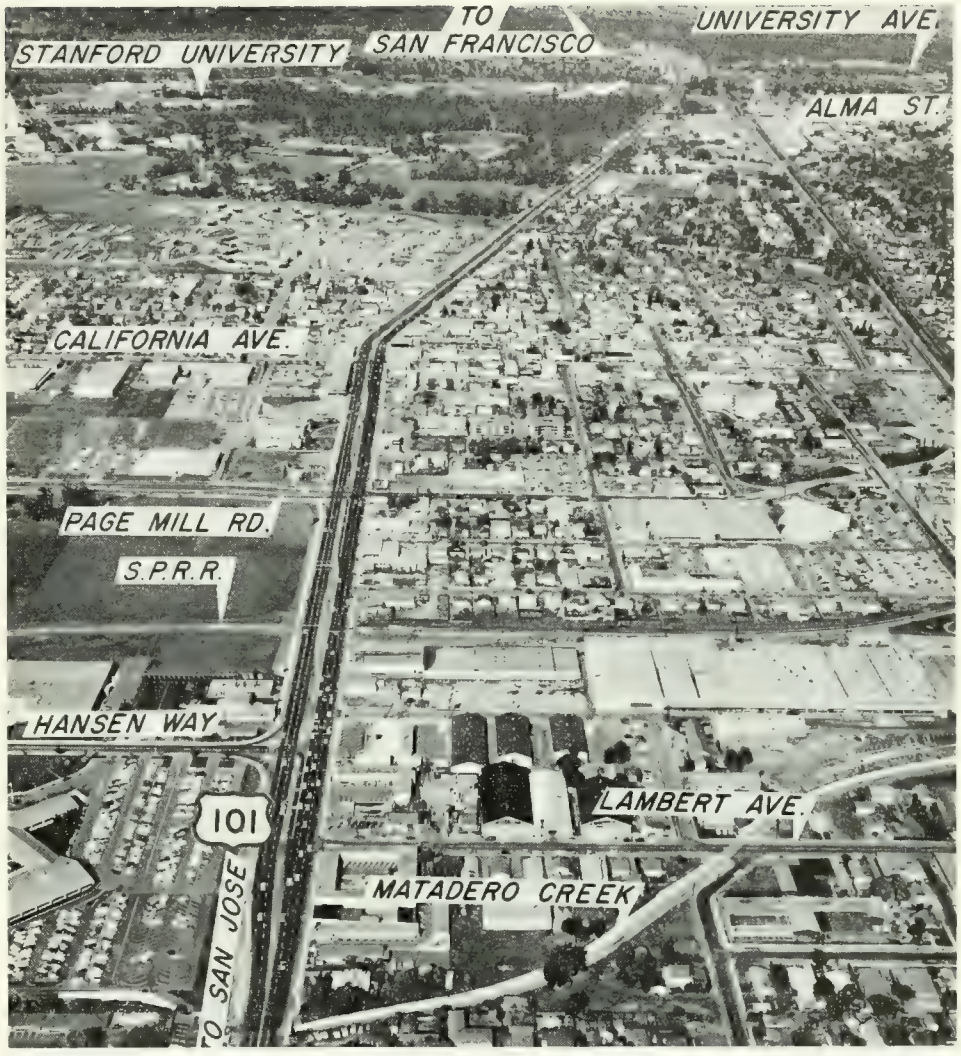
Sign Route 17

Also under construction by the same contractor is a 3.4-mile project for widening existing State Sign Route 17 between Bayshore Freeway and Forest Avenue. This work which includes adding one lane in each direction in the median and expansion of the Coleman Avenue Interchange will cost approximately $1,124,000. Both types of median barrier will be installed as a part of this project.

A sum of $4,465,000 has been included in the 1963-64 budget for the next unit of Junipero Serra Freeway. This project is a 4.7-mile portion extending westerly from the going contract in San Jose to Stelling Road in Cupertino. The freeway will be elevated in the vicinity of Lawrence Expressway-Stevens Creek Boulevard and depressed from Saratoga-Sunnyvale Road to Stelling Road. Three interchanges will be constructed, and one separation structure. That portion of the project between Saratoga-Sunnyvale Road to Stelling Road will only be graded on this unit.

Sign Route 9

Widening of the existing highway between the Southern Pacific Railroad at Azule in Saratoga and El Camino Real in Sunnyvale was recently completed. Funds in the amount of $695,700 were allotted for this 5.4-mile project which will provide a four-lane arterial with channelizations at five intersections. Rights-of-way for this improvement were provided by the cities and county. The contractor on this project was Raisch Construction Co.



Recently completed widening on El Camino Real (U.S. 101) between University Avenue and Matadero Creek in Palo Alto.

Stevens Creek Freeway

Funds in the amount of $6,560,000 are included in the 1963-64 budget for construction of the first unit of the Stevens Creek Freeway. This initial four-lane (ultimate six-lane) freeway will generally parallel Stevens Creek and replaces existing Sign Route 9. The limits of this project are between Homestead Road in Cupertino and Bayshore Freeway in Mountain View just south of the Stierlin Road Interchange, 5.5 miles. The project includes seven interchanges, plus structures at three different locations on Stevens Creek and over the Southern Pacific railroad in the vicinity of Evelyn Avenue. Funds have also been budgeted for a co-operative project for the construction of an overcrossing at Middlefield Road within the limits of the above project.

El Camino Real

In Palo Alto, a 2.1 mile project, costing $1,440,000 was recently completed by McGuire & Hester, between University Avenue and Matadero Creek. El Camino Real was widened from four lanes to a six-lane divided city street, including installation of a lighting system, longitudinal storm drains and landscaping median islands. The Mayfield Avenue pedestrian undercrossing was also extended.

Farther to the south, a contract was completed in September of 1962 by Leo J. Piazza Company to widen and reconstruct 10.9 miles of U.S. 101 between El Toro Avenue in Morgan Hill and Ford Road in San Jose. The project included installation of drain-

age facilities and construction of left turn lanes. $887,000 was expended on this work.

Funds in the amount of $200,000 are included in the 1963-64 budget for a 3.6 mile resurfacing project between El Toro Avenue in Morgan Hill and Llagas Creek. This work will include left turn storage lanes at the major intersecting roads.

U.S. 101 Bypass

Present development of this important artery contemplates the construction of interchanges at the several important intersecting roads in the next few years. The first of such projects was completed during the past year by Raisch Const. Co. An overcrossing was constructed at Tully Road over U.S. 101 and 1.3 miles of interchange ramps were provided at a cost of $896,000.

A $100,000 project has been budgeted for functional and three planting of 2.2 miles of Bayshore Freeway between Morse Avenue and Agnew Road in the vicinity of San Jose. Bids for this work were opened on May 8, 1962.

Landscaping Jobs

In November 1962, a $61,500 contract was completed for landscaping and the installation of an irrigation system on two miles of Bayshore between University Avenue and Matadero Creek in Pal Alto. A similar project, between west of Brokaw Road and Coyote Creek in San Jose, a distance of 2.9 miles, was completed in September 1962. This work cost approximately $103,000 and included the planting of almost 2,700 trees.

Other Routes

Work is underway on the construction of 1½ miles of State Route 113 between El Camino Real near Grant Road and existing Route 113 in the vicinity of Bernardo Avenue. Funds in the amount of $1,478,000 are allotted for the construction of this work which includes three structures. The project provides four lanes of a future six-lane freeway to Dana Street and two lanes from Dana Street to Bernardo Avenue.



Construction in progress on the Sign Route 17-Route 239 interchange in San Jose. From this point, Interstate 280 starts toward San Francisco.

Recent Adoptions

Of considerable importance to the continued growth and development of the metropolitan San Jose area are two recent route adoptions. The portion of the Guadalupe Freeway between Bayshore Freeway and Coleman Street was adopted by the highway commission at its September 1962 meeting; and the following month the route was adopted for new Route 5 through San Jose from Junipero Serra Freeway at Moorpark Avenue to Alum Rock Avenue east of Jackson Street. This latter routing generally proceeds easterly from Junipero Serra through the central San Jose area to Bayshore Freeway and swings northerly to Alum Rock Avenue.

Milpitas Hearing

Studies for the remainder of the route between Alum Rock Avenue and existing Route 5 in the vicinity of the Warm Springs area of Fremont have been completed and were presented at a public hearing in Milpitas on March 27, 1963.

Funds in the amount of $350,000 have been budgeted for 5.9 miles of resurfacing and shoulder reconstruction on State Sign Route 152 (Pacheco Pass Road) between 2.9 miles west to 2.9 miles east of Bell's Station.

Work is presently in progress for grading, resurfacing and channelization for left turn lanes on State Sign Route 17 at Summit Road. In August, a project for landscaping this route between Bascom Avenue and 0.2-mile south of Route 68 (Bayshore Freeway) was completed at a cost of $176,000.

High Fashion Seat Belts. In anyone doubts that seat belts are "in," the following information should set him straight. You can buy the belts in genuine ocelot ($35), mink ($50) and chinchilla ($100) in a New York department store.

SANTA CRUZ COUNTY

The second of several projects to convert the existing State Sign Route 1 expressway between Santa Cruz and Rob Roy Junction to full freeway standards is under construction by Granite Construction Company. The first of these contracts, 1.5 miles between Soquel Wharf Road in Capitola and Soquel Avenue, was completed in January of 1962.

On the work presently under way interchanges are being constructed at State Park Drive and Park Avenue. This 2.9-mile project includes the construction of frontage roads and will cost approximately $1,372,000.

Watsonville Bypass

Plans are now complete for a $2,700,000-project, budgeted 1963-64, for the rough grading and construction of structures on the "Watsonville Bypass." This project will extend nearly four miles, from 1.2 miles south of the Pajaro River to 1.5 miles northwest of Buena Vista Drive on Cabrillo Highway, bypassing Watsonville to the west.

The initial work includes the placing of an embankment surcharge on the graded area to assist in the stabilization of the embankment through this marshy terrain. The surcharge will remain in place for approximately one year.

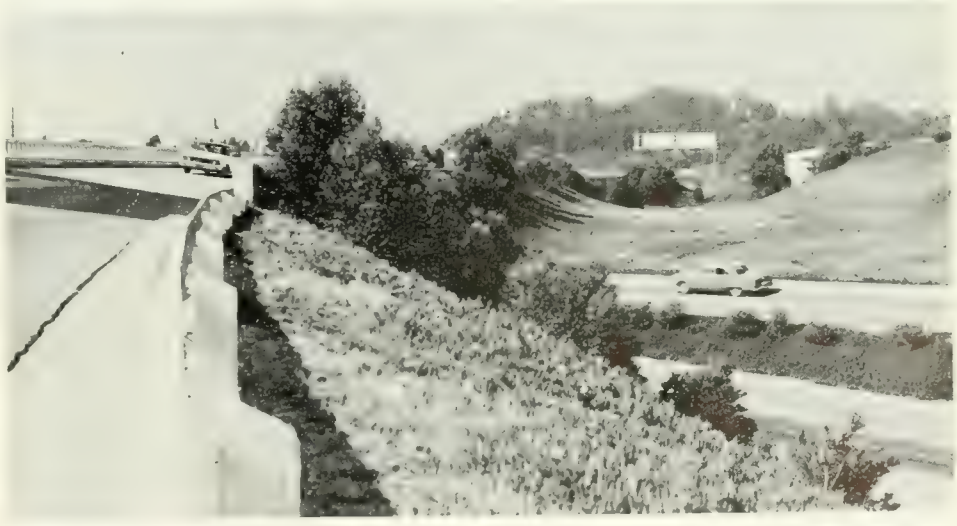
The project also includes rough grading on portions of Route 67 from the new alignment on Sign Route 1 to Main Street in Watsonville.

A future contract will remove the surcharge, pave four lanes of the ultimate six-lane freeway and complete the structures between the Monterey county line and 0.2 mile northeast of Roach Road.

A contract was completed on January 31, 1963, for the modification of signal systems at five major intersections in Watsonville on existing Sign Routes 1 and 152 and Legislative Route 67. This work, performed by Steiny & Mitchell Inc., cost approximately $24,500. In September of 1962, a $208,000 project for the installation of drainage facilities and resurfacing of 7.1 miles of portions of the Cabrillo Highway between Main Street in



Santa Cruz and the beach communities of Capitola and Aptos to the east. Step by step, the former expressway east of Morrisey Boulevard is being converted to freeway.



A fine example of landscaping in District IV near the City of Santa Cruz. In the coastal air the iceplant is particularly well adapted.



Watsonville and Rob Roy Junction was completed. Granite Construction Co. was the contractor on this work.

Sign Route 17

A contract for functional planting of trees on State Sign Route 17 between new Sign Route 1 and Granite Creek Road is currently in progress. Edgewood Farms and Gardens is the contractor on this $98,000 project.

A $59,600 project is currently under way at the intersection of State Sign Routes 5 and 17 at Summit Road. This contract, being performed by Granite Construction Company, includes widening and resurfacing.

L. C. Smith completed a $477,000 contract on Sign Route 17 in December. This work consisted of the installation of drainage improvements, and placing base and surfacing on 6.4 miles of the existing four-lane facility between the Santa Clara county line and 0.6 mile north of Granite Creek Road.

SONOMA COUNTY

Freeway projects on U.S. 101 (Redwood Highway) recently completed, under construction or budgeted, together with the construction presently in progress on State Sign Route 12 in the vicinity of Santa Rosa, will insure improved and safer travel conditions for the motoring public. Additional work on State Sign Route 12, west of Sebastopol, and State Sign Route 1 will also afford easier access to the recreational areas and scenic beauties of western Sonoma County.



U.S. 101 (Redwood Highway)

Two major projects on U.S. 101 were opened to traffic this past winter, completing the Redwood Highway to full freeway standards between the Marin county line and Lytton, northerly of Healdsburg, except for portions south of the Petaluma River and within Santa Rosa. A 9.6-mile contract, which cost approximately $4,386,000, from the north city limits of Santa Rosa includes six interchanges. This work, performed by Guy F. Atkinson Company, included freeway paving to Windsor and rough grading from there to Grant Creek.

The second contract constructed five miles of freeway between Windsor and Healdsburg including paving of the aforementioned rough grading. Four structures were included. This work was done by Ball and Simpson at a cost of $3,020,000. Trees were

planted on the completed freeway between the Russian River and Lytton Forestry Station at a cost of approximately $12,000.

(See "Santa Rosa North," March-April 1963 issue of *California Highways and Public Works.*)

Under Construction

North of Healdsburg, a 3.6-mile project generally known as the "Asti Bypass" is being constructed. It will provide four lanes of an ultimate six-lane freeway between 0.8 mile south of Washington School Road and 0.6 mile north of Hiatt Road. Funds in the amount of $2,297,000 are allotted for this work, which includes two interchanges. McNamara Ltd. is the contractor.

An additional project south of Washington School Road has been budgeted, and should be advertised this summer. It provides $1,200,000 for construction of freeway between 1.7 miles north of Canyon Road and 0.8 mile south of Washington School Road. The 1.7-mile project includes the Chianti Undercrossing designed to provide separation for a connection between the frontage roads and bypasses the sharp curve known as Zanzi's Corner.

Santa Rosa Area

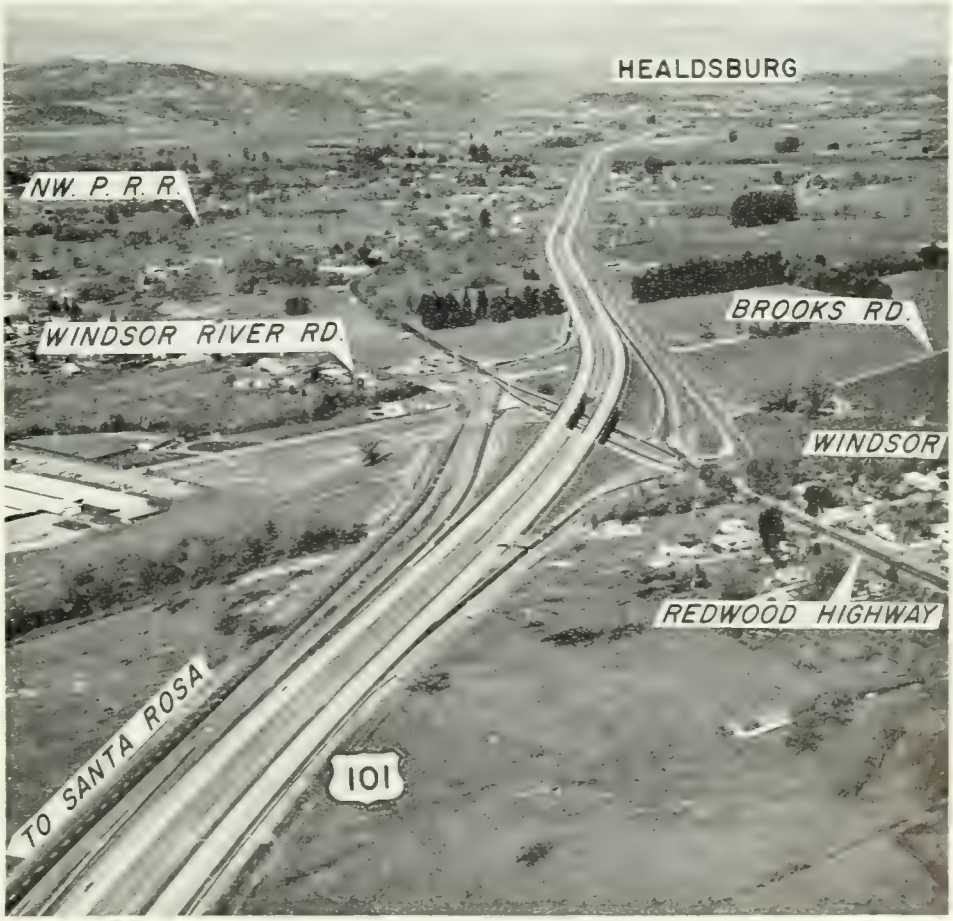
Five and one-half miles of freeway and expressway construction is underway on State Sign Route 12 between Occidental Road, east of Sebastopol, and South E Street in Santa Rosa. This project is being constructed completely on new alignment bypassing the roadside development in the Roseland area west of Santa Rosa.

The most prominent feature is the construction of the first interchange in Santa Rosa, the three-level separation at U.S. 101. Also being constructed across U.S. 101 is the pedestrian overcrossing in the vicinity of Earle Street. Five additional structures are being constructed. This work is being done by Peter Kiewit Sons' Company and is expected to be opened to traffic early in 1964.

A project for widening the existing two-lane facility on State Sign Route 12 between Farmer's Lane and Brush Creek in Santa Rosa was completed in January. The construction of this three-quarter-mile portion



Recently completed realignment of State Sign Route 12 in the vicinity of Duncan Mills. Austin Creek bridge in foreground.



Northeasterly to Healdsburg from Windsor. The Old Redwood Highway crosses under the freeway at Windsor interchange.



Construction progress on State Sign Route 12 in Santa Rosa viewed easterly from Dutton Avenue.

completed almost three miles of widening for this route along the city streets of Santa Rosa, east of U.S. 101. This interim project cost approximately $259,000 and included construction of a bridge across Brush Creek. Necessary rights-of-way, in addition to $20,000 for construction, were furnished by the City of Santa Rosa.

Work was also completed on another interim project on this route in the vicinity of Kenwood. This work involved the reconstruction of three curves west of that locality. O. C. Jones & Company was the contractor on this $24,300 project.

Other Improvements

A project for the relocation of nearly two miles of Sign Route 12 between Duncans Mills and east of Austin Creek, about three miles west of Monte Rio was completed on January 11, 1963. This work provides improved alignment and eliminates the narrow, tortuous Duncans Mills grade. It included the construction of a new reinforced concrete box girder bridge over Austin Creek. The cost of this two-lane construction was approximately $680,000.

Alignment for a portion of the remainder of the route between Austin Creek and west of Monte Rio was adopted by the Highway Commission in December. This section will be developed as a two-lane conventional highway.

In March, the Highway Commission adopted a new route for Sign Route 1 between 0.5 mile east and 0.6 mile west of Fort Ross Road. This location bypasses the Fort Ross compound and has been suggested by the State Division of Beaches and Parks to allow better utilization of this historical area.

STATUS OF DISTRICT IV—FREEWAY AND EXPRESSWAY PROJECTS

April 1963

Description	Total miles	Completed projects		Under contract		Budgeted		Right-of-way expended and budgeted
		Miles	Construction cost	Miles	Construction cost	Miles	Construction cost	
U.S. 101 AND BYPASS								
Bayshore and James Lick Memorial Freeway, U.S. 101 Bypass; Southern Freeway in San Francisco to Ford Road South of San Jose	52.9	52.4	[a]$60,738,000				$1,874,000	$27,934,420
Southern Freeway	4.7		[b]7,366,000	4.2	$14,960,000	0.5	2,050,000	20,428,120
James Lick Memorial Freeway	3.0	3.0	11,445,000					12,870,440
Central Freeway	1.8	1.8	11,653,000					8,533,099
Golden Gate Freeway	1.1					1.1	5,100,000	58,000
Southern Embarcadero Extension Freeway	4.4			0.5	5,500,000	0.9	6,143,000	7,614,653
Ford Road South of San Jose to San Benito county line	27.9	5.8	1,093,000					545,839
Redwood Freeway; Golden Gate Bridge to Mendocino county line	84.3	69.0	[c]51,961,000	7.4	10,316,000	1.6	1,740,000	19,131,667

STATUS OF DISTRICT IV—FREEWAY AND EXPRESSWAY PROJECTS—Continued

April 1963

Description	Total miles	Completed projects		Under contract		Budgeted		Right-of-way expended and budgeted
		Miles	Construction cost	Miles	Construction cost	Miles	Construction cost	
U.S. 40—San Francisco to Carquinez Bridge (portions)	18.2	18.2	[d]62,065,000	..		..	420,000	13,432,537
U.S. 50								
MacArthur Freeway; Distribution Structure to Castro Valley	15.3	6.8	15,715,000	6.0	23,680,000	.....	*6,960,000	59,778,664
Castro Valley to San Joaquin county line	31.4	31.4	11,647,000	..		..		4,105,337
Sign Route 17								
Nimitz Freeway, Distribution Structure to Bayshore Freeway at San Jose	41.3	41.3	55,860,000	....	4,912,000			22,522,792
Santa Cruz to San Jose (portions)	16.4	16.4	17,728,000	.....	98,000	.....	.....	4,805,101
U.S. 40 near Albany to U.S. 101 near San Rafael (portions)	9.9	2.2	1,973,000	..	.....	.....	.....	2,658,907
Sign Route 9 and 21								
Warm Springs to U.S. 50	17.7	.	.....	4.7	6,200,000	.....	.. ..	2,428,174
U.S. 50 to Walnut Creek	16.0	3.5	3,010,000	6.8	[i]13,379,000	2.5	7,500,000	11,703,535
Walnut Creek to Monument	3.4	3.4	9,322,000	....	. ...	.....	.. . ...	6,415,743
Monument to Solano county line	7.4	5.4	15,716,000	2.0	1,800,000	.....	.....	4,939,038
Sign Route 9 north of Route 21 in Fremont	4.4	.....	... .	.....	.....	..	.....	583,594
Grove-Shafter Freeway and Sign Route 24								
Sign Route 17 in Oakland to Warren Boulevard	4.8	.....	.. . .	.....	.....	. .	. .	10,654,082
Warren Boulevard to Walnut Creek	11.0	6.4	9,725,000	3.1	19,084,000	1.5	3,805,000	5,590,041
North of Monument to Sign Route 4, Concord	3.4	.....	....	3.2	3,150,000	....	.....	1,822,278
Embarcadero Freeway	1.5	1.5	14,792,000	.....	.....	.....	1,400,000	13,159,831
Park-Presidio Freeway, Golden Gate Bridge to Fulton St.	2.1	1.2	1,448,000	.....	.....	.....	.....	3,000
Junipero Serra Freeway, from Bayshore Freeway in San Jose to San Francisco county line	47.4	.....	.....	4.7	5,950,000	8.5	14,908,000	43,151,683
Cabrillo Highway								
Moss Beach to Lake Merced Boulevard in San Francisco	17.0	5.4	2,804,000	....	.....	3.3	4,136,000	9,204,705
Watsonville to 4 miles south of Davenport (portions)	22.8	13.9	[e]7,523,000	2.9	1,250,000	5.0	2,700,000	4,670,198
Junipero Serra Freeway to Nimitz Freeway								
Nineteenth Avenue Freeway, Junipero Serra Freeway to Alameda county line at San Mateo Bridge (portions)	8.0	.....	... .	2.3	4,800,000	. .	225,000	7,146,412
San Mateo county line to Nimitz Freeway	6.8	....	.. . .	. .	... .	....	....	807,471
Pacheco Pass; 1 mile east of Bell's Station to Merced county line	5.3	5.3	1,301,000	.	....	.....	350,000	12,393
West of U.S. 101 to Bypass U.S. 101 in Redwood City (Route 214)	1.1	. .	. . . . .	.	....	1.1	[h]2,282,000	2,835,997
Stevens Creek Freeway, Sign Route 17 to Bayshore Freeway at Mountain View	13.6	. .	.. .	. .	.. ..	5.5	6,669,000	5,508,237
West Valley Freeway, U.S. 101 South of San Jose to Sign Route 17	10.0	.. .	... .	....	. ... ..	...	. .	827,023
Mountain View-Alviso Freeway; El Camino Real to Nimitz Freeway	10.5	5.5	2,088,000	1.5	1,475,000	..		2,832,337
Freeway Connection from Nimitz Freeway to U.S. 50 (Route 228)	2.2	2.2	2,803,000	....	. ..	. .	.....	2,236,000
Bay Farm Island Bridge and Approaches	0.6	0.6	2,062,000	. ...	.. .	.....	....	165,000
Webster Street Tube (and Posey Tube)	1.1	1.1	17,566,000	. ..	1,100,000	.....	.....	2,616,729
Warren Boulevard Freeway; Sign Route 24 near Lake Temescal to MacArthur Freeway	5.6	4.1	[f]5,654,000	0.6	1,919,000	.....	45,000	2,489,099
Tracy Triangle (Route 110); U.S. 50 to San Joaquin county line	0.4	.....	.....		.. ...		. ...	367,005

STATUS OF DISTRICT IV—FREEWAY AND EXPRESSWAY PROJECTS—Continued

April 1963

Description	Total miles	Completed projects		Under contract		Budgeted		Right-of-way expended and budgeted
		Miles	Construction cost	Miles	Construction cost	Miles	Construction cost	
Shepherd Canyon Freeway; Warren Boulevard Freeway to Sign Route 24	10.3							687,579
Sign Route 84; 2.6 miles east of Dumbarton Bridge to Sign Route 9 at Niles	5.7							
East of Route 239 to west end of Dumbarton Bridge	6.4							1,080,000
Route 108, Sign Route 21 to U.S. 50 near Livermore	9.7							
Arnold Industrial Freeway; Hercules to Antioch Bridge (Sign Routes 4 and 24)	34.1	14.7	4,737,000					2,286,636
Sign Route 12; Sebastopol to Kenwood	17.7			4.1	5,200,000			6,117,546
Sign Route 29; Solano county line to Calistoga	36.9	23.2	4,703,000	2.2	1,625,000			4,934,581
Sign Route 12; Sign Route 29 to Solano county line	3.3							
Sign Route 48; Sign Route 37 to Solano county line	2.3							
Sign Route 37; from Redwood Freeway at Ignacio to Napa	13.4	7.2	5,900,000					818,007
Route 229; Sweeney Ridge to Bayshore Freeway	4.0							423,000
Guadalupe Freeway; Bayshore Freeway to Coleman Market	2.7							
Totals	683.2	352.9	$420,398,000	56.3	$126,398,000	31.5	$68,307,000	$362,936,530

[a] Advertising of project depends on co-ordination with S.F.B.A.R.T.D.
[b] Includes $300,000 contributed by co-operating agencies.
[c] Includes total of $1,600,000 by City of San Francisco.
[d] Includes total of $5,000,000 by Golden Gate Bridge and Highway District.
[e] $29,117,000 toll bridge funds in this amount.
[f] $6,833,000 from toll bridge funds.
[g] City of Oakland and Alameda County contributions included in this figure.
[h] Includes $690,000 by District V.
[i] Includes total of $1,051,000 by City of Redwood City.
[j] County of Alameda contribution included in this figure.

ANNUAL DISTRICT RIGHT-OF-WAY AGENTS MEETING HELD IN SACRAMENTO



Headquarters and district right-of-way agents held their annual meeting in Sacramento on May 2 and 3. Discussion of problems and exchange of information on recent studies were the chief topics of discussion.

District staff attending were (seated around table, clockwise): W. J. Kenney, Frank Kane and John Daniels, all District IV; Gilbert Mulcahy, District III; Clarence Piper, District II; William Sloane, District I; Glenn Hippensteil, District VI; Rudolf Hess, chief right-of-way agent (head of the table); Howard Chamley, District VII; John Ritz, District XI; Wayne Hubbard, District X; John Burke, District IX; Jack Asbill, District VIII; J. W. Greathead, E. P. Jones, and D. C. Gardner, all District VII; (seated, middle row right) Fred Moore, District V; (middle row sixth from right) Erwin Hovde, District IV; and (standing sixth from right) A. M. Lynch, District VII.

New Striper

Improved Unit Faster, Safer, More Versatile

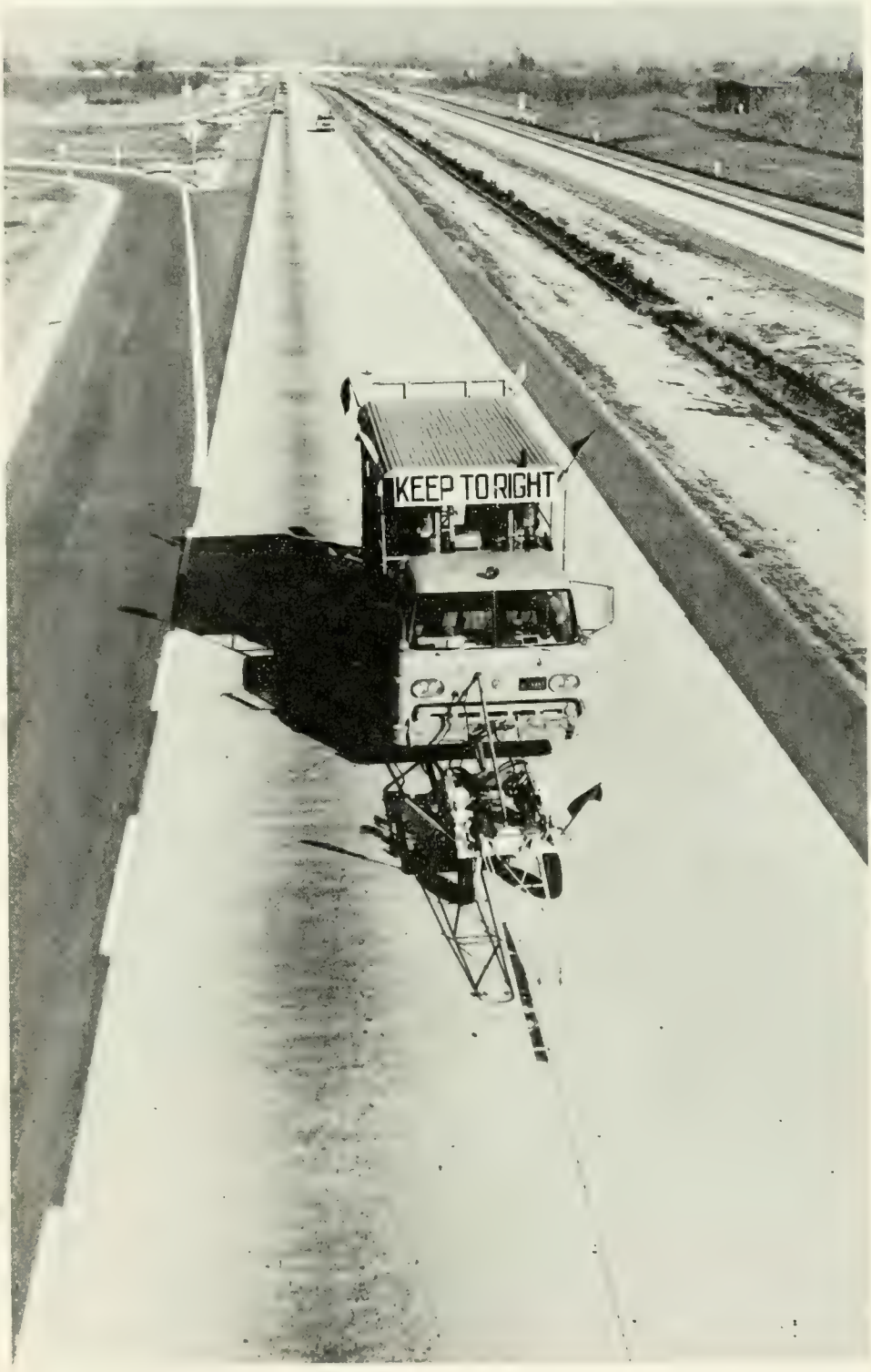
By R. C. GROUT, Assistant Equipment Engineer

In this age of missiles, booster rockets and possible interplanetary travel, we hear a great deal of news about guidance systems. While everybody shows plenty of interest in this system, perhaps they do not realize that one of the most used and possibly the primary guidance system for the major volume of traveling people in the world today is the traffic stripe. While ordinarily given very little thought, it probably is used and abused more than any other single guidance system which exists today.

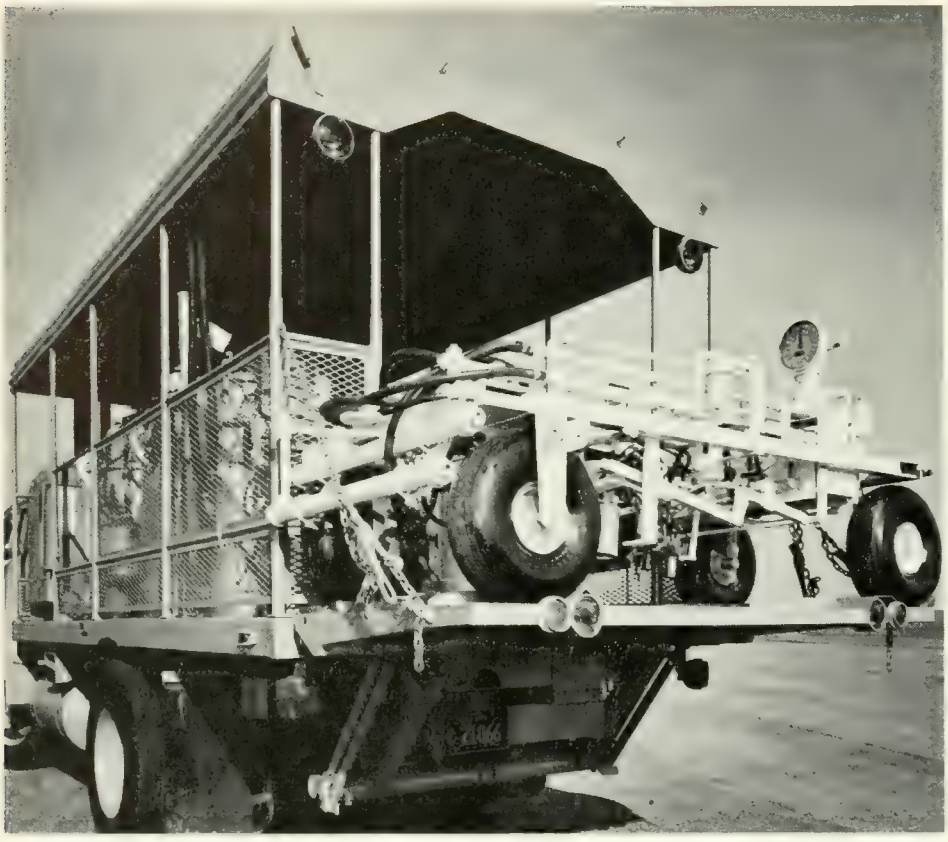
In order to provide the vehicle operator with the most economical and yet most acceptable guidance system, the equipment department and maintenance department of the California Division of Highways have constantly sought to develop a safer and more economical method of applying the various stripes to the pavement. The January-February, 1960, issue of *California Highways and Public Works* carried the first article dealing with our improvements to the traffic line marker. Again in the July-August 1961 issue, a second article described the new traffic line marker that had been developed. There are now further developments which have improved both the economics and and safety of operating the new striper.

More Rapid Method Needed

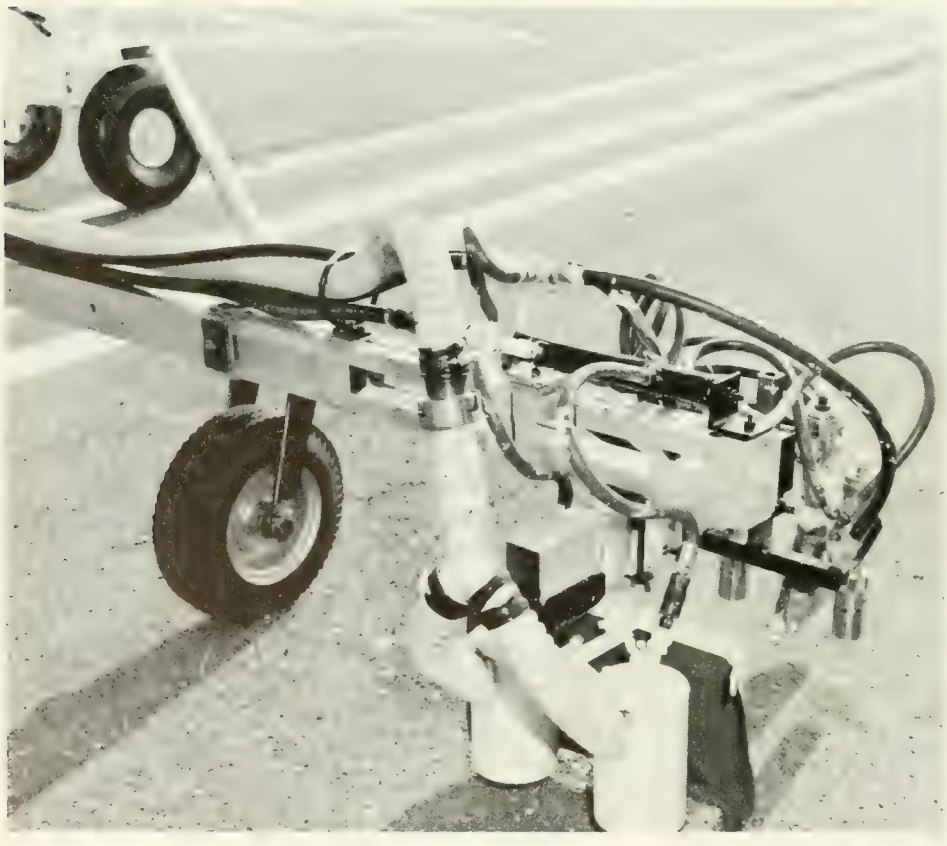
Because of the increase in the number of miles of new multilane freeways, which usually at least doubles the mileage of stripe needed, as well as the necessity of maintaining existing highly traveled two-lane roads, a more rapid process of applying marking stripes was found to be necessary. After a thorough appraisal of the requirements of the operating departments involved, it was determined that the following items should be incorporated in the lastest design of the traffic striper:



New unit in operation on U.S. 40 east of Roseville.



Paint striping truck loaded and ready to move to a new location.



Paint guns and bead dispensers on the end of the lightweight extension arm.

1. Safety for operators.
2. Maximum production.
3. Minimum traffic tie-up or hazard.
4. Overall efficient and economical operation.

A unit embracing the above requirements was designed by the equipment department, with advice and assistance from the maintenance department, and several such units were constructed and put into service in 1962.

Models Carefully Studied

The first models were carefully studied during the first few months of operation, and the results were compared with existing equipment used by California, other states and commercially obtainable units. The operators and crews working with the units were interviewed and notes were made of any improvements that they thought could be made. The final list of suggestions was prepared and incorporated the following ideas:

1. Elimination of carrying the reflectorizing materials (beads) on the sulky.
2. Better striping characteristics.
3. Safe flushing system.
4. Provision for offset painting.
5. Single gun application for an eight-inch-wide line.
6. Provision for a bonding agent.

These features were studied by the design section of the equipment department and suitable changes were made in the plans for new units.

Several of these units have been constructed and are now in service. Crews using the latest model were well pleased with the machine and quality of the work. The striper can now be operated entirely from the cab and is capable of not only painting four-inch and eight-inch stripes from the sulky located directly in front of the propelling vehicle but also is capable of painting stripes at a distance from four to thirteen feet from the machine. All materials are carried on the propelling vehicle, which provides for a more rapid and economical operation.

Can Paint Three Colors

Specifically the machine carries 300 gallons of paint and 750 pounds of re-

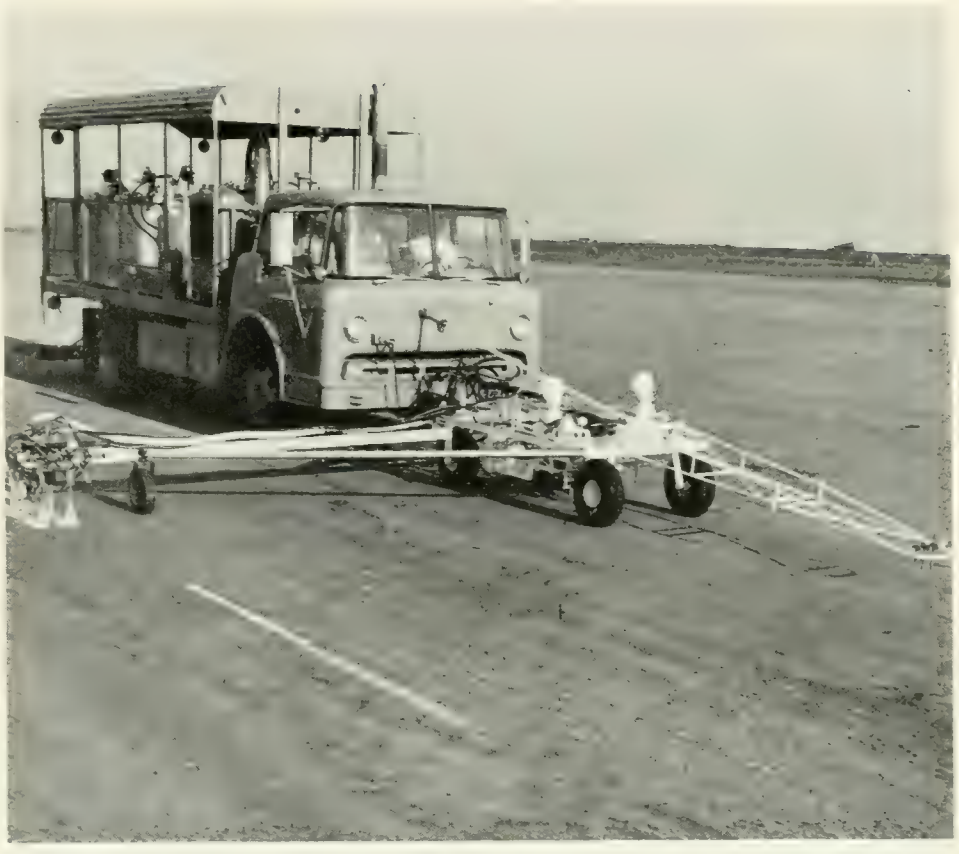
fleeting beads. It will paint four-inch and eight-inch stripes in any combination of white and yellow paint. The AASHO standard, 9-foot long painted by 13-foot gap broken stripe, is painted automatically by using a sensing device operated from the driveline of the truck which electrically activates the valves on the paint guns. Provision is made to paint three colors—white, yellow, or black—and either single or double solid or broken lines, or triple lines.

When painting, this machine can travel at speeds up to 15 miles per hour. This essentially means that traffic and road conditions govern the speed that stripes can be applied.

The provision of complete control from the cab of the truck is incorporated in the new machine and with the application of quick drying lacquers, we are now able to complete the work in a much safer manner.

As a result of several comprehensive articles concerning the development of this machine appearing in several trade journals, requests for plans and specifications of the units have been received from numerous state, county, city and foreign governments.

Reports from the district maintenance departments that have used the new model are quite favorable. Costs are comparable with the older model. The cost per mile per stripe should be reduced with these advantages.



The new unit showing the extension arm in action.



The former sulky type unit.

Storms, Snow, Slides Cause Road Closures

Heavy snow and blizzard conditions closed U.S. 40 over Donner Summit for seven hours on April 15 and eight hours on the 19th. High water in the Yolo Bypass closed State Sign Route 16, the River Road to Woodland, for 17 days starting the morning of April 8. The Emerald Bay section of State Sign Route 89 was closed for the last 24 days in the month. Rock slides closed State Sign Route 1 between Big Sur and San Carpojo Creek on April 6, 7, 26 and 27, and State Sign Route 128 at the Monticello Damsite on April 14 and 15.

Seismic Tests—2

Followup Report Compares 1960 Prediction With Results

By DEWEY W. KNITTEL, Associate Engineering Geologist, and
MARVIN L. McCAULEY, Assistant Engineering Geologist



In the May-June 1960 issue of *California Highways and Public Works* magazine, an article appeared entitled "Seismic Tests." The use of seismic refraction data to predict the rippability of rock in proposed excavations was described in this article. The seismic survey was run along portions of the proposed relocation of U.S. Highway 6 through Escondido Canyon, Los Angeles County. The area is about midway between Palmdale and Saugus.

Grading on this portion of the Antelope Valley Freeway has now been completed, and this followup article will attempt to compare the predicted results from the seismic data with the actual excavation methods used during construction.

Area Geology

The area under discussion is located in the Soledad Basin, which lies north of the western San Gabriel Mountains in the Transverse Range Province. The area is composed of both gently rolling hills and steep canyons with near vertical walls up to 350 feet high. The rock encountered along the seismic survey consisted of massive sandstones and torrential conglomerates of the Vasquez Formation (Oligocene) and the Tick Canyon formation (Lower Miocene), which is composed of green, buff and reddish

PHOTO BELOW. One of the seismic blasts set off along the relocation line of U.S. Highway 6 through Escondido Canyon in Los Angeles County.



brown siltstones, sandstones and conglomerates.

Pleistocene terrace remnants occur locally throughout the area and are composed of abundant rock clasts in a noncemented silty sand matrix. Minor folding and faulting was observed in the area of the seismic survey.

Seismic Theory

The theory of seismic refraction is based primarily on the measurement of the length of time required for a wave front to reach a point that is a known distance from the energy source. The waves may travel directly from the source to the detector, or at some critical angle they may be refracted and travel along the contact of two different velocity zones. Wavelets are generated which travel back to the detectors on the surface (Figure 1). The arrival time for various distances from the energy source are recorded (Figure 2) and a time-distance graph is constructed (Figure 3). This graph will show the velocities of the different zones, and the depth to the change in velocity can be computed by the formulas given in Figure 4.

A 12-channel portable refraction seismograph was used for obtaining the information on the job. Each geophone (essentially a magnet and a coil) when disturbed by the shock wave sets up a current which is amplified and then recorded as a separate trace on photographic paper. Elapsed times on these seismograms can be picked to the nearest millisecond. The minimum time segment imposes a limit of accuracy on the computations.

Rippability Factors

A material is considered rippable if, without being preblasted, it can be excavated by standard equipment. The velocities obtained in a seismic refraction survey cannot be used by themselves to determine rippability. The velocities, used as a guide, must be related to a number of other factors. These include the rock type, the degree of weathering, the amount and type of fracturing or jointing, the bedding, and other results of the tectonic history.

Nongeologic factors such as the type of equipment used by the con-

TABLE I

ESTIMATED VS. ACTUAL CUBIC YARDS BLASTED

Station Limits *Type of Material*	*Total cubic yards in cut* *	*Estimated percent requiring blasting* **	*Estimated cubic yards blasted* †	*Actual cubic yards blasted* ‡	*Actual per cent blasted*
455 = 460 Cement conglomerate	904,600	55	497,500	488,000	54
470 = 483 Interbedded sandstone and siltstone	601,000	55	330,500	122,900	20
487 = 491 + 50 Interbedded sandstone, siltstone and volcanic intrusive	80,000	20	16,000	0	0
511 = 514 + 50 Interbedded sandstone and torrential conglomerate	156,800	15	23,500	11,300	7
525 = 563 Interbedded sandstone, siltstone and conglomerate	975,000	100	975,000	950,000	98
615 = 652 Basalt flows	605,800	45	272,600	236,700	39
	3,323,200		2,115,100	1,808,900	

Percent error—9.2 percent.

* Calculated by district design department.
† Based upon seismic data.
‡ Figures supplied by contractor.



Looking west long the Antelope Valley Freeway construction. Interchange in the foreground is Ward Road with the existing Sierra Highway to the right and Econdido Canyon Road to the left.

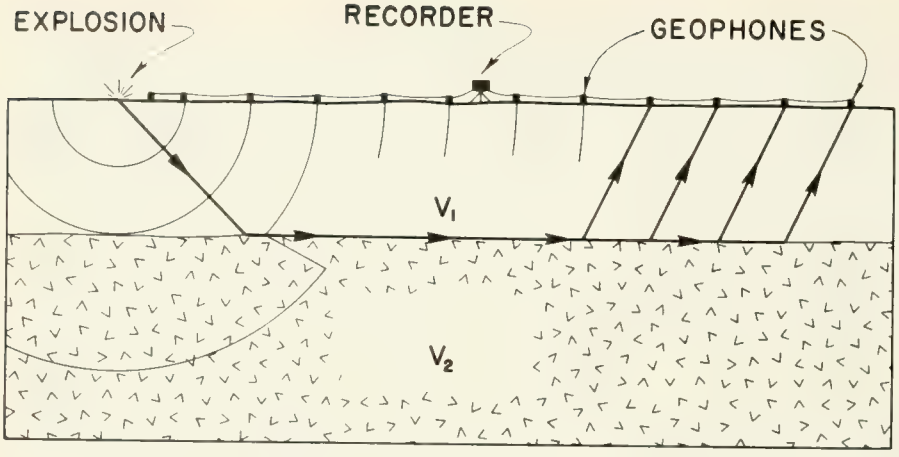


FIGURE 1. The placement of detectors (geophones) and possible wave paths.

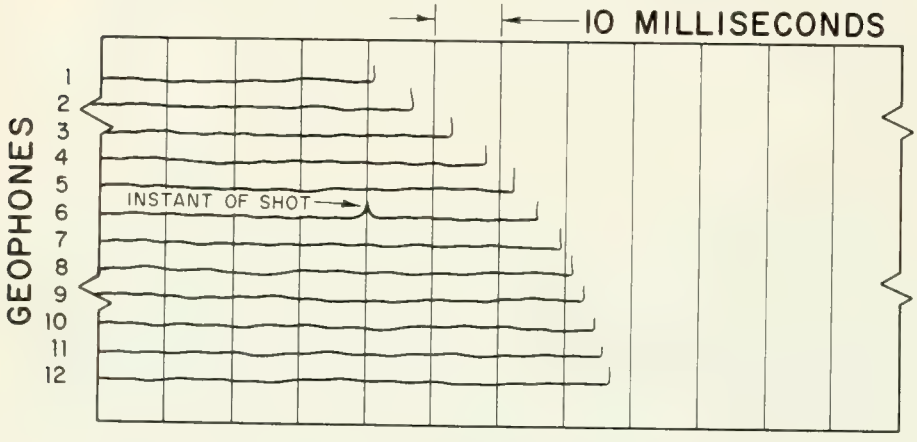


FIGURE 2. A seismogram showing the times recorded by each geophone.

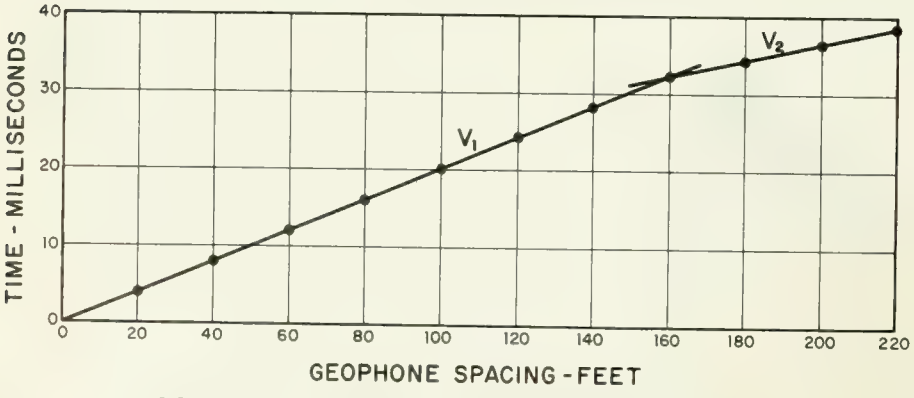


FIGURE 3. A time-distance graph constructed from the seismogram.

V_0 = Velocity of 1st material
V_1 = Velocity of 2nd material
V_2 = Velocity of 3rd material
X_c = Distance intercept
T_1 = 1st time intercept
T_2 = 2nd time intercept
Z_0 = Thickness of 1st layer
Z_1 = Thickness of 2nd layer

Formula for two layer problem

$$Z_0 = 1/2\sqrt{\frac{V_1 - V_0}{V_1 + V_0}} \cdot X_c$$

Formula for three layer problem

$$Z_1 = 1/2\left(T_2 - \frac{2Z_0\sqrt{V_2^2 - V_0^2}}{V_2\ V_0}\right)\left(\frac{V_2\ V_1}{\sqrt{V_2^2 - V_1^2}}2\right)$$

FIGURE 4. Depth formulas used in computations.

tractor will affect rippability. It can readily be seen that two D-9 tractors with mounted rippers used in tandem will succeed in economically ripping a higher velocity material than a D-8 tractor with a towed ripper. Even the skill and experience of the individual equipment operator will affect the amount of rock that can be excavated without preblasting. Also, it is the option of the individual contractor whether a borderline material should be ripped or preblasted. Therefore, the quantity of material requiring blasting is influenced by the amount and type of equipment owned by the contractor and by his method of operation.

Suitability of the Area

The theoretical conditions upon which seismic refraction is based are rarely found in nature. In this area the dip of the bedding planes had to be compensated for by shooting both updip and downdip from the recorder. These velocities were then averaged to obtain a representative velocity for the material since shooting in one direction only will give a false impression of the velocity and depth to the underlying material. Offset bedding created by minor faults along with associated jointing and the presence of volcanic intrusives added to the difficulty of interpreting the seismic records. The alternation of hard and soft beds must be taken into account since velocity waves cannot be recorded for a lower velocity material underlying a more dense layer. Thus, when the first high-velocity layer is recorded, it must be assumed that all material below that depth has an equally high velocity.

Unsuspected Source

In the cut area between Station 470 and Station 483 a large unsuspected source of perched water was encountered during the excavation. A saturated material will often have a seismic velocity of about 5,000 feet per second. Based upon hindsight it is now felt that the seismic interpretation was influenced by this water and probably accounts for the large percentage of error in this particular cut section.



A 1960 photo looking west along the proposed location of the Antelope Valley Freeway indicated by the superimposed line. Some 800,000 cubic yards of material were removed from the cut through this bluff.



1960 photo of the Antelope Valley location looking east toward the back of the rock bluff shown in the above photo. Centerline of the freeway is shown by the superimposed line.

Since field conditions were not ideal and because it was not known what type of excavation equipment would be used, a somewhat conservative velocity was chosen as the breaking point between ripping and blasting. All material having a velocity of 5,000 feet per second or higher was described as requiring blasting while that material with velocities below 5,000 feet per second was considered rippable.

Calculated in Table 1 are the figures showing the correlation between the anticipated yards of excavation needed to be blasted, based upon the seismic survey, and the actual amount preblasted during the construction with these station limits.

Conclusions

The velocities obtained in a seismic refraction survey can be a useful guide for estimating the amount of blasting that will be required. This information is of special value to prospective bidders and also to the design department. It must be stressed that the amount of information and the degree of accuracy are dependent upon the experience and skill of the operator-interpreter. This job shows that the method can be applied in areas where conditions are not ideal for seismic surveys provided the limitations of the method and the equipment are considered. Overestimation of the amount of material requiring blasting by 9.2 percent is a reasonable error when all factors concerning this job are considered.

Improvements Slated For Two Bay Bridges

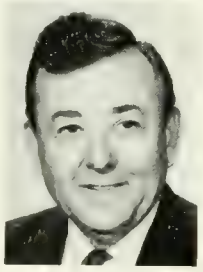
A contract for $950,462.50 was awarded on April 19 for resurfacing the upper deck of the San Francisco-Oakland Bay Bridge. This resurfacing is part of an overall $35,000,000 reconstruction project to convert the structure to carry five lanes of one-directional traffic on each level. The changeover to one-way traffic is expected by early July although the new contract will require six months to complete.

Governor Appoints New State Architect

Governor Edmund G. Brown on May 7 announced his appointment of Carl C. McElvy, 58, of the University of California at Los Angeles, as State Architect.

The Governor praised McElvy as "an outstanding architect and a proven administrator who will bring a fresh point of view and a sense of urgency to the task of making our state buildings the most beautiful in the country."

McElvy has been the principal architect at U.C.L.A. since 1946 during which time he did major planning, coordination and administrative work.



CARL C. McELVY

McElvy's office was created by the 1961 Legislature. His appointment is subject to Senate confirmation. A committee of eight architects and contractors, appointed by Governor Brown last July, recommended McElvy's appointment to the $20,000-a-year job.

The Governor praised the work of the Division of Architecture and its acting chief, Earl W. Hampton, who has held this post since the division chief, Anson Boyd, retired last year.

"In our new position as the leading State in the nation we will seek to be first also in the beauty of our construction projects—buildings, freeways and recreational facilities," the Governor said.

McElvy was born in Los Angeles and educated in public schools there. He received his degree in architecture from the University of Southern California and has been a registered architect since 1939.

Prior to his appointment at U.C.L.A., McElvy worked for the City of Los Angeles and the federal government.

He is a member of the American Institute of Architects and received the Pasadena chapter's 1958 award for outstanding contribution to the advancement of the profession.

He and his wife, Ruth, have three children.

District VII Loses Three Survey Supers

Three supervisors in District VII's survey section are retiring this summer. Two of them, surveys supervisor Wayne M. Blotter and chief of survey party Patrick Devine, have the longest state tenure in the district, with 44 and 43 years respectively, while surveys supervisor Henri Compagnon has 32 years.

Both Blotter and Devine helped align original roadways in District VII, including the Angeles Crest and Pacific Coast Highways. In recent years, Blotter has supervised construction survey work on the Golden State, Santa Ana, and San Bernardino Freeways, Devine has concentrated on projects in the West Los Angeles-Santa Monica area, including some six miles of the San Diego Freeway for which his survey party won the 1961 Bonneroo Award.

Compagnon has been chief of party or surveys supervisor for many of the largest projects in District VII, including the four-level interchange and the San Diego Freeway through the Santa Monica Mountains.

Blotter joined the Division of Highways at his hometown, Sacramento, in June 1919. He served a year with District III and three years with District XI, the balance of his time being spent in District VII. His wife Aimee works for District VII's advance planning department.

A native of Los Angeles, Compagnon joined the Division of Highways in District I and later transferred to District VII where he has been continuously employed except for World War II when he served with the U.S. Army Engineer Corps in Alaska. An amateur archeologist, he has donated to museums many Indian artifacts, skeletons, and fossils found while working on highway projects. His only son, Henry M., is assigned to District VII's traffic department.

Devine, born and educated in San Diego, worked with the San Diego Road Commission for a year and a half before transferring to Highways. His entire career has been with District VII.

Wrong-way Drivers

One Out of Five Does It Knowingly

One out of five wrong-way drivers on freeways and expressways is knowingly and deliberately driving against oncoming traffic, and 60 percent of the wrong-way driving incidents resulted from entering the freeway via an offramp.

These are conclusions from a study by the Division of Highways of 500 wrong-way drivers cited by the California Highway Patrol in the first nine months of 1962.

Other findings revealed were:

Almost one-third of these drivers had been drinking.

An equal number of violators pleaded "honest confusion."

A greater percentage of men past 49 and women past 39 were involved than their proportion of the State's registered drivers would indicate.

One-sixth of the incidents were caused by carelessness.

Nearly half of the incidents occurred during daylight, including dawn and dusk.

Only 1 in 10 occurred in bad weather—rain, snow or fog.

Visibility was good in 84 percent of the incidents.

Traffic volume was light when 44.3 percent occurred; heavy for 7.8 percent.

Illiteracy, or the inability to understand signs, was responsible for only 2 percent of the incidents.

Co-operative Study

The study was one of several research projects on traffic safety being administered by the Highway Transportation Agency and conducted by the Division of Highways, the California Highway Patrol and the Department of Motor Vehicles under a $100,000 grant by the Legislature in 1961. The Division of Highways had the lead responsibility for this particular study.

"Since the average driver who encounters adverse conditions of lighting, weather, traffic, and even occasionally confusing highway signing and design, still manages to drive in the proper direction," Hill said, "it seems that the most important cause of wrong-way driving is the mental condition of the driver himself."

The study classified drivers in each incident as either under the influence of alcohol (in four subclassifications); confused; careless; deliberately violating the law; or illiterate; although it was recognized that in many incidents a combination of factors was possible.

Intoxicated Drivers

Of the 31.5 percent of the offenders who had been drinking, one-half of these were so obviously intoxicated that they could give no explanation for their behavior to the arresting officer.

WRONG-WAY DRIVING INCIDENT

Freeway X
Expressway
Other

Co. SBd Rte. 31 Sec. A

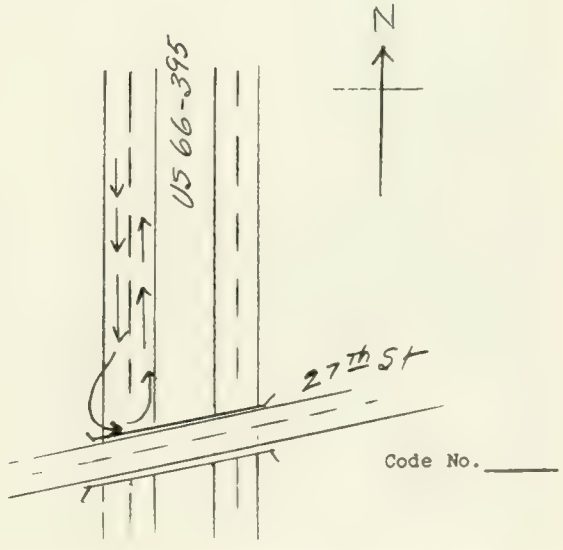
Date 07-62 Hour —

Location US 395 5/6 Lanes at 27th St Overpass Direction N/B

How it occurred:		Driver data:		Other conditions:	
Entered from Off-ramp		Sex M Age 51		Light	1
Entered from undivided road		Sobriety		Weather	1
Entered from expressway		Confused		Visibility	G
Made U turn	4	Careless		Traffic	M
Unknown		Intentional	8		

Description: Driver stated he was looking for US 99 and made U turn to go back because he thought he had gone too far

Diagram:



One of the forms used by the Division of Highways to record wrong-way driving accidents is shown above.

Another large group, equal in number to the drinking drivers, were motorists who claimed they were confused by unfamiliarity with the freeway, misleading signing, transitions from undivided roads to freeways involving detours or barricades, and confusing interchange or ramp designs.

"Drivers' complaints regarding confusing situations were carefully investigated by highway engineers," Hill said. "Such complaints may well offer the best leads to improved highway design and signing."

Confusion Amongst Elderly

The study indicated that confusion as a cause of wrong-way driving was more prevalent among the elderly offenders.

The deliberate violators comprised the third largest group. The commonest maneuver by this type of driver was doubling back against oncoming traffic after passing a desired offramp or intersection.

"One wrong-way driver in six is just plain careless," Hill said. "His typical statements to the arresting officer are, 'I didn't see any signs. I was looking at the ocean,' or 'I had been having an argument with my wife and was upset.'"

The seriousness of the wrong-way driving problem is indicated by accident statistics. During 1961, there were 13 head-on collisons on urban and rural freeways that resulted in death for 19 persons. There were 13 more in the first 8 months of last year with 17 killed and 17 injured.

Sign Effectiveness Studied

As 60 percent of the wrong-way driving incidents resulted from entering a freeway via an offramp, a second phase of the study is in progress at the Institute of Transportation and Traffic Engineering at the University of California, Los Angeles, to measure the effectiveness of various signs in preventing improper entry.

This study employs a "driving simulator" technique developed by the I.T.T.E. in which driver reaction to highway features is tested by projecting a motion picture of the highway onto a curved screen in front of and behind an automobile mounted on blocks and rollers.

Left Turns on Expressways

Unlike freeways, expressways have intersections at grade. The study revealed that nearly half the wrong-way movements on expressways were caused by drivers entering the intersection and making left turns into the nearest lanes, or by making right turns after proceeding through the opening between opposing lanes. This tendency is aggravated where there are service roads adjacent and parallel to the expressway.

According to the traffic engineer, "with a four-lane expressway and two two-lane frontage roads, for a total of eight roadway lanes—the outer frontage roads permitting driving in both directions and the center divided expressway one-way roadways—some drivers become confused trying to relate the various lanes with the correct direction of travel. They get in trouble by not keeping track of the lanes they have crossed."

Wrong Way From Onramp

A small number of wrong-way incidents resulted from drivers' leaving freeways via onramps after passing desired offramps, or from making a left turn at the end of an onramp when the motorists found the direction of travel on the freeway was not what they wanted.

"Some of these people claimed to be confused," said Hill, "but it's hard to believe that they could make the clumsy U-turn the ramp design would force on them without knowing they were making an illegal maneuver."

Incorporated Cities Receive $9,000,000

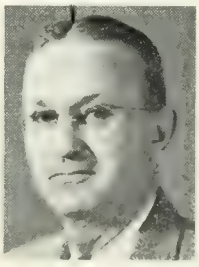
A total of $9,986,507.61 in revenues from the five-eighths-cent-per-gallon gas tax was apportioned by the Department of Public Works to the 382 active incorporated cities in California in April under the provisions of the Streets and Highways Code.

The Cities of Vista and San Marcos, both in San Diego County, were incorporated during this quarter.

Equipment Engineer McFadden Retires

William L. McFadden, supervising equipment enginer for the Division of Highways, will retire June 1 ending a 34-year career with the State.

As assistant equipment engineer in charge of administration, McFadden was in charge of the recent revision of the equipment rental system of the division's equipment department which is now responsible for some 9,400 units worth more than $34,000,000, ranging from jackhammers to rotary snow plows.



W. L. McFADDEN

McFadden was born in Panaca, Nevada, and studied engineering at the University of Idaho. He began his engineering career in 1919 as a rodman with the city engineering staff of Idaho Falls. In 1922 he joined the Nevada Highway Department and in 1926 was appointed City Engineer of Las Vegas. He went to work for the California Division of Highways as a resident engineer in 1928 and was assigned to projects in the Marysville, San Bernardino and Imperial Valley areas.

He was appointed assistant construction engineer for the San Diego area in 1933. He joined the staff of the highways equipment department in Sacramento in 1949.

McFadden is a veteran of the 1916 Mexican Border Campaign, the American Expeditionary Force and Army of Occupation during World War I and served with the Navy Seabees in the South Pacific during World War II, retiring with the rank of commander.

He is a member of the American Society of Military Engineers, the Reserve Officers Association, the American Legion, the California State Employees' Association (of which he was state president in 1941) and the Sacramento Stamp Collectors Club.

McFadden and his wife, Lula, live at 4625 Staggs Way in Sacramento.

Merit Awards

Five Division Employees Receive Superior Accomplishment Awards

The California State Merit Award Board has announced approval of five superior accomplishment awards for employees of the Division of Highways—the first time that the division's personnel have been so honored.

The five so honored were senior bridge engineer Roger D. Sunbury, Route 2, Stockton; senior engineer welding technologist Paul G. Jonas, 3065 Stanton Circle, Carmichael; reproduction supervisor Ralph D. Chamney, 5100 Serrania, Woodland Hills; and a husband and wife team, John and Peggy Unruh, senior delineators, 1122 Bellhaven Avenue, West Covina.

Superior accomplishment awards are voted for achievements by employees which management recognizes as making an exceptional contribution to the efficiency or economy of state government, or to exceptional improvement in its operation.

Robert B. Bradford, Administrator of the State Highway Transportation Agency presented the awards to Sunbury and Jonas in Sacramento on April 8. Chamney and Mr. and Mrs. Unruh were presented their awards by Metropolitan District Engineer E. T. Telford in Los Angeles on April 22.

Sunbury and Jonas won the Dr. L. I. Hewes Award for outstanding contributions to western highway development last June. In his letter recommending them for the award, State Highway Engineer J. C. Womack praised Sunbury for combining steels, ranging from ordinary structural steel to the newest high strength steels, into long bridge structures with both marked economy and improved appearance.

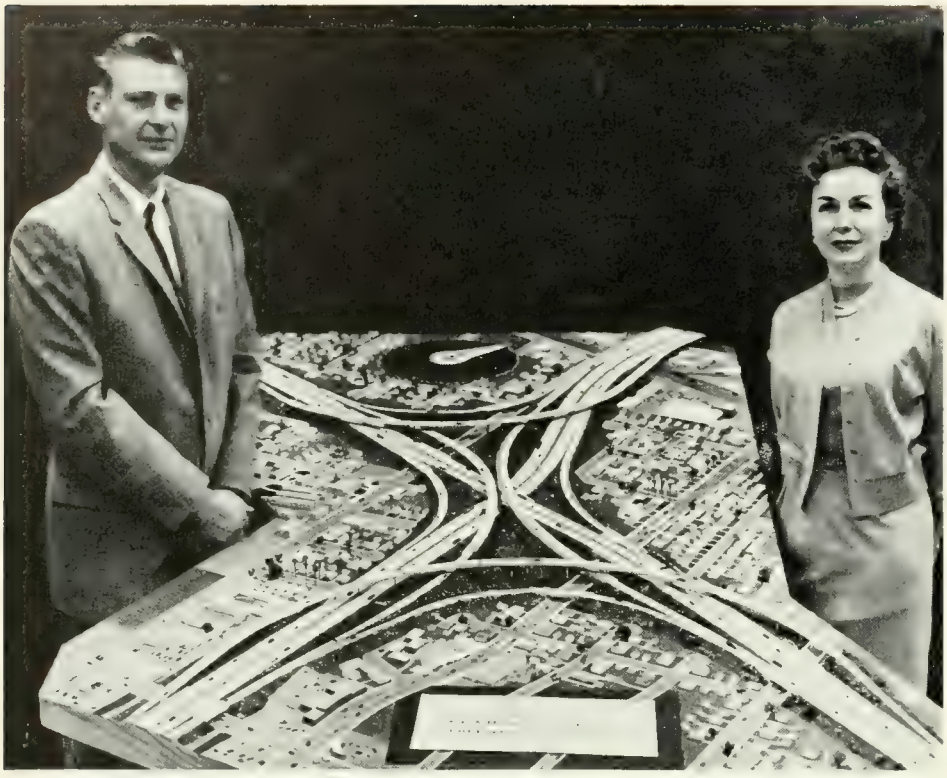
"By his foresight," Womack said, "Mr. Sunbury has opened up new horizons for structural designers. He was able to effect an $800,000 savings on the Carquinez Bridge by combining three different types of steel. This large, double cantilever bridge . . . established a new high standard for clean, uncluttered truss design."



LEFT TO RIGHT. Senior Bridge Engineer Roger D. Sunbury and Senior Engineer Welding Technologist Paul G. Jonas are presented their award certificates and gold watches by State Highway Transportation Administrator Robert B. Bradford while State Highway Engineer J. C. Womack looks on.



Ralph D. Chamney (left) shows sample kit explaining a composite photo system he devised to Division of Highways Metropolitan District Engineer E. T. Telford, who presented the award April 22d.



A husband and wife team, John and Peggy Unruh, senior delineators of the California Division of Highway's District VII office in Los Angeles, pose with a scale model of the Santa Monica-San Diego Freeway Interchange which they constructed in their home on their own time and donated to the division. They will be presented a superior accomplishment award.

Praising Jonas for his work in advancing and standardizing the technological aspects of welding which make the use of high-strength steels practical and economical, Womack added that through the joint efforts of the two men, California has been able to set precedents in major, long-span highway structures that are now being duplicated throughout the nation.

Chamney devised a composite photographic system which permits the base maps and drawings prepared by the numerous departments involved in highway planning to be combined in an infinite variety of ways to suit the user's requirements, eliminating the need for costly and time-consuming redrawing.

"One example of Mr. Chamney's accomplishments," said Los Angeles Metropolitan District Engineer E. T. Telford, "lies in the development and use of overlays produced photographically which brought usable information to the right-of-way department from the design department many months—possibly a year—before it would otherwise have been available."

The District VII Right-of-way Department estimated a 90-percent saving of time in preparing its maps by employing Chamney's techniques.

Mr. and Mrs. Unruh, working in their home on their own time, constructed a scale model of the Santa Monica-San Diego Freeway interchange, and donated it to the Division of Highways at a cost to themselves of approximately 600 man-hours of labor and a cash outlay of $210.

The model proved of great value to design, bridge and maintenance engineers, prospective bidders, right-of-way appraisers and negotiators, and members of the Los Angeles City Engineer's staff.

It also was viewed by Los Angeles residents during months of public showings at the West Los Angeles City Hall and the Annual Home Show in the Los Angeles Memorial Sports Arena, as well as at other locations.

K. A. MacLachlan

Kenneth A. MacLachlan, former economist with the Division of Highways and pioneer in the adaption of tabulating and computing machines for highway engineering purposes, died on April 18 in a Houston, Texas, hospital.

MacLachlan had been living in Santa Cruz, California, since he retired in 1958.

MacLachlan was born in New Haven, Connecticut, and obtained his education in England and at the University of California, graduating with a B.S. degree in 1921. He served with the Navy in World War I and then with the U.S. Bureau of Public Roads.

Early in his state career MacLachlan was one of the group who formulated a definite highway signing policy at the first step toward California's present well-defined system of warning, regulatory, and directional signs.

Soon afterward he was assigned supervision over the California Highway Transportation Survey of 1934.

Under his supervision the Division of Highways was the first agency of its kind to use punched card equipment to analyze highway accidents and detect problem locations; to use the co-ordinate system of analysis for traffic data; to depict the results of origin and destination surveys in the form of "trip desire line" contours; and to adapt gyroscopic equipment for highway survey purposes by means of a specially equipped vehicle.

He is survived by his wife, Florence, of Santa Cruz, and a son, Donald, of Soda Springs.

52 JOBS ADVERTISED

The Department of Public Works advertised for bids in April on 52 projects at an estimated cost of $39,428,900. There were 41 contracts for $11,444,400 awarded during the month and 24 contracts for $45,992,800 completed.

Bids from 221 contractors were opened on 36 projects, an average of 6.1 bidders per project.

Reed, Legal Chief, Dies in Sacramento

Robert E. Reed, Chief of the Division of Contracts and Rights-of-way, collapsed and died on a golf course in Sacramento on April 22. He had been head of the division since 1950.

Reed had charge of a staff of more than 80 attorneys dealing with the legal aspects of state highway construction including rights-of-way and contract negotiations. He also represented the Department of public Works before legislative committees and as adviser to the Legislature in developing and amending the Streets and Highways Code and other statutes.



ROBERT E. REED

Reed was born in Piqua, Ohio, in 1905. He graduated from the University of Idaho in 1926 and the Stanford University Law School in 1928.

Before entering state service as an assistant legislative counsel in 1930, he practiced law in Oakland. He joined the Department of Public Works in 1934 and became a deputy attorney general in the State Attorney General's office in 1944.

He returned to the legal division of the Department of Public Works in 1949 and was appointed division chief in 1950, succeeding the late Clifton R. Montgomery.

He was a member of the American and Sacramento County Bar Associations and from 1958 to 1961 was chairman of the legal affairs committee of the American Association of State Highway Officials. He was also a member of Phi Alpha Delta, the Commonwealth Club and the University Club of Sacramento.

Reed is survived by his wife, Mildred; son, Robert E., Jr., of La Canada; daughters, Jane of Oakland, and Mrs. John Spurlock, of Palo Alto.

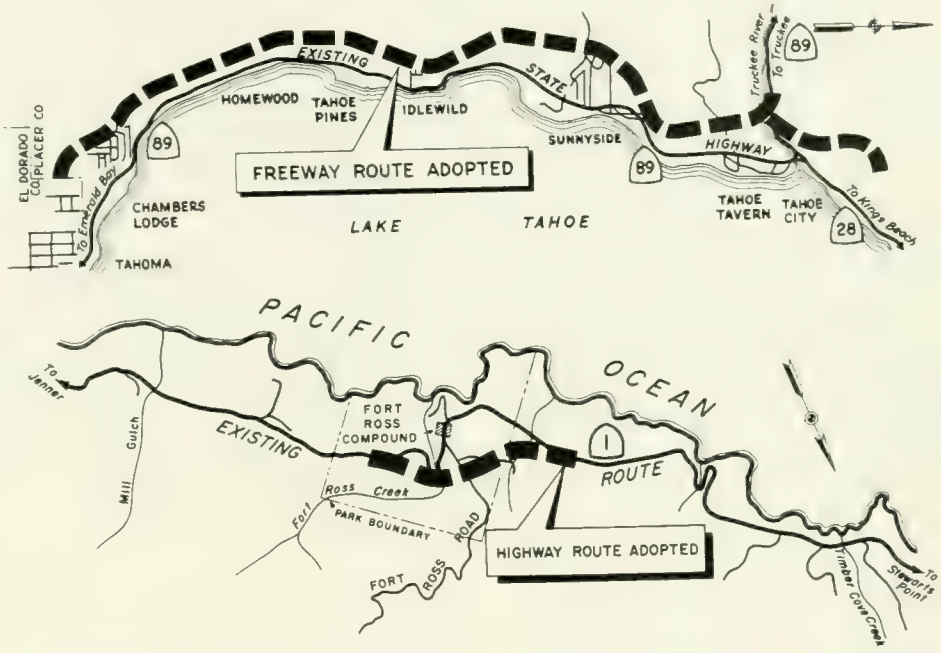
The Department of Public Works has asked the State Personnel Board to schedule a civil service examination for the position of Chief, Division of Contracts and Rights-of-way, looking toward the selection of a successor to Robert E. Reed.

The duties of acting chief of the division have been assigned in the meantime to Harry S. Fenton, assistant chief.

COMMISSION ADOPTS FREEWAY, HIGHWAY ROUTINGS

Although it took a number of routings under consideration, the California Highway Commission adopted only three freeway routes and one conventional highway route at its March and April meetings.

Freeway routes were adopted in March for eight miles of Sign Route 89 and one mile of Sign Route 28 in the Lake Tahoe area of Placer County.



Sign Route 89

For Sign Route 89 the adopted route runs to the west of the present highway and generally parallel with it between the El Dorado county line and 0.2 mile north of the Truckee River, about a mile west of Tahoe City.

For Sign Route 28 the adopted route extends northerly from Sign Route 89 about a mile west of Tahoe City.

Plans of the Division of Highways call for the construction of a four-lane divided "scenic highway" type of highway facility.

In April the commission adopted a freeway routing for four miles of Sign Route 25 in the vicinity of Tres Pinos, San Benito County, between 0.1 mile south of Bolado Road and Fairview Road.

The adopted route follows the existing highway except for a slight swing to the north around Tres Pinos. The existing highway runs through the community.

Conventional Highway

The conventional highway routing is for the relocation of 1.1 miles of Sign Route 1 in Sonoma County in the vicinity of Fort Ross. The adopted route skirts Fort Ross compound on the north and avoids areas of historical interest. The present highway runs through the compound of the historical monument.

The Department of Public Works has awarded contracts totaling $9,291,324 for the construction of the Sierra Branch Conservation Center near Sonora for the rehabilitation of prison inmates and the conservation of the State's natural resources. Scheduled to open in the spring of 1965, the new facility will house 1,216 inmates in two dormitories.

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

HIGHWAY TRANSPORTATION AGENCY

ROBERT B. BRADFORD . . . Administrator

DEPARTMENT OF PUBLIC WORKS . . . JOHN ERRECA, Director

FRANK A. CHAMBERS . . . . Chief Deputy Director

RUSSELL J. COONEY . . Deputy Director (Management)
HARRY D. FREEMAN . . Deputy Director (Planning)

T. F. BAGSHAW . . . . . Assistant Director
JOHN H. STANFORD . . . . . Assistant Director

JUSTIN DuCRAY . Departmental Management Analyst
S. ALAN WHITE . . Departmental Personnel Officer

DIVISION OF HIGHWAYS

J. C. WOMACK . . . State Highway Engineer, Chief of Division

CHAS. E. WAITE . . . Deputy State Highway Engineer
J. P. MURPHY . . . Deputy State Highway Engineer
J. A. LEGARRA . . Deputy State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
GEO. LANGSNER . . Assistant State Highway Engineer
FRANK E. BAXTER . Assistant State Highway Engineer
J. C. BURRILL . . . . . Comptroller
JOHN L. BEATON . . . . . Equipment Engineer
C. G. BEER . . . . . Urban Planner
L. L. FUNK . . . . . Planning Engineer
GEORGE A. HILL . . . . . Traffic Engineer
F. N. HVEEM . . . Materials and Research Engineer
J. F. JORGENSEN . . . . . Construction Engineer
SCOTT H. LATHROP . Personnel and Public Information
C. T. LEDDEN . . City and County Projects Engineer
H. C. McCARTY . . . . . Office Engineer
E. J. L. PETERSON . . Program and Budget Engineer
R. V. POTTER . . . . Systems Research Engineer
E. L. TINNEY . . . . . Maintenance Engineer
W. L. WARREN . . . . . Engineer of Design
A. L. ELLIOTT . . . . Bridge Engineer—Planning
L. C. HOLLISTER . Bridge Engineer—Special Projects
I. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area

Right-of-Way

RUDOLF HESS . . . . . Chief Right-of-Way Agent
DEXTER D. MacBRIDE . . . . . Assistant Chief
RAY E. O'BIER . . . . . Assistant Chief
R. S. J. PIANEZZI . . . . . Assistant Chief
JACQUES T. ZEEMAN . . . . . Assistant Chief

District I, Eureka

SAM HELWER . . . . . District Engineer

District II, Redding

H. S. MILES . . . . . District Engineer

District III, Marysville

ALAN S. HART . . Assistant State Highway Engineer

District IV, San Francisco

J. P. SINCLAIR . . Assistant State Highway Engineer
R. A. HAYLER . . . . . District Engineer
HAIG AYANIAN . . . . . District Engineer
C. F. GREENE . . . . . District Engineer

District V, San Luis Obispo

E. R. FOLEY . . . . . District Engineer

District VI, Fresno

W. L. WELCH . . . . . District Engineer

District VII, Los Angeles

E. T. TELFORD . . . Metropolitan District Engineer
A. L. HIMELHOCH . . . . . District Engineer
A. C. BIRNIE . . . . . District Engineer
A. W. HOY . . . . . District Engineer
R. E. DEFFEBACH . . . . . District Engineer

CALIFORNIA HIGHWAY COMMISSION

JOHN ERRECA . . . . Chairman and Director of Public Works
JAMES A. GUTHRIE . . Vice Chairman San Bernardino
ARTHUR T. LUDDY . . . Sacramento
ROGER S. WOOLLEY . . . San Diego
ABRAHAM KOFMAN . . . San Jose
FRANKLIN S. PAYNE . . Los Angeles
WILLIAM S. WHITEHURST . . . Fresno
JACK COOPER, Secretary . . . Sacramento

District VIII, San Bernardino

C. V. KANE . . . . . District Engineer

District IX, Bishop

C. A. SHERVINGTON . . . . . District Engineer

District X, Stockton

JOHN G. MEYER . . . . . District Engineer

District XI, San Diego

JACOB DEKEMA . . Assistant State Highway Engineer

State-owned Toll Bridges

CHARLES L. SWEET . . . . . Bridge Engineer

DIVISION OF CONTRACTS AND RIGHTS-OF-WAY (LEGAL)

HARRY S. FENTON . . . . . Acting Chief Counsel

HARRY S. FENTON . . . Assistant Chief (Sacramento)
HOLLOWAY JONES . . Assistant Chief (San Francisco)
GEORGE C. HADLEY . . Assistant Chief (Los Angeles)

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

NORMAN C. RAAB . . . . Chief of Division
BEN BALALA . . . . . Principal Bridge Engineer

DIVISION OF ARCHITECTURE

CARL C. McELVY . . . . . State Architect, Chief of Division

EARL W. HAMPTON . . . . . Deputy Chief, Architecture and Engineering
HUBERT S. HUNTER . . . . . Deputy Chief, Administrative
MERLE A. EWING . . . . . Chief Structural Engineer (Schools)
ARTHUR F. DUDMAN . . . . . Assistant State Architect (North)
TOM MERET . . . . . Assistant State Architect (South)
CLARENCE T. TROOP . . . . . Chief Construction Supervisor

DIVISION OF AERONAUTICS

CLYDE P. BARNETT . . . . . Director, Chief of Division

85894 5 63 52,800

printed in CALIFORNIA STATE PRINTING OFFICE



View of girder placement from canyon floor.

(Continued from inside front cover)

o move the heavy girders into place was lecided on. Steel was moved by truck from he railroad at El Centro, the contractor constructing a special haul road for his ve-icles.

The route is a historic one. For centuries Indians used it on their annual trek to the coast for salt. It was used officially for mail as early as 1858 after the federal government discovered the route previously in use passed through Mexico.

A full story on this project will be carried in *California Highways and Public Works* next year, after the job is completed. All photographs are by Robert Dunn, of the Division of Highways Photography Section.

Piers were slip-form construction.



Closeup of girder placement.



SEATTLE PUBLIC LIBRARY
4TH & MADISON
SEATTLE 4, WASHINGTON

rnia Highways and Public Works
ISION OF HIGHWAYS
P. O. Box 1499
RAMENTO CALIFORNIA

RETURN REQUESTED

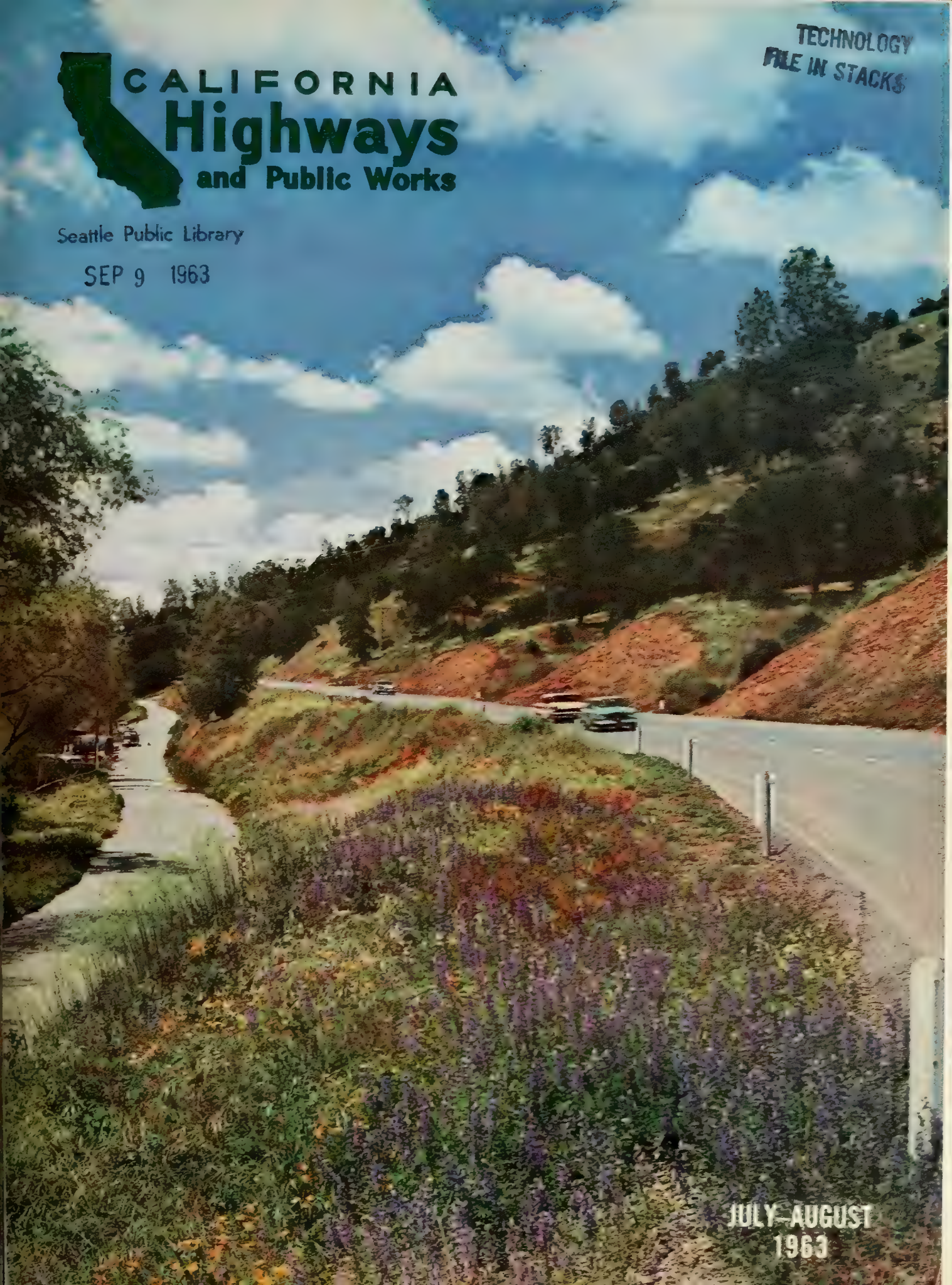
BULK RATE
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152



TECHNOLOGY
FILE IN STACKS

CALIFORNIA Highways and Public Works

Seattle Public Library
SEP 9 1963



JULY–AUGUST
1963

The three photos on this page show construction on a section of Interstate 80 (old U.S. 40) in the vicinity of Cisco Grove, and below, a shot of the first cross-Sierra route, portions of which can still be seen near the present highway. The bridge across the Truckee River here will carry four lanes of traffic. This work is part of one of the few remaining contracts underway which will make the road four lanes all the way to the state line.





California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

Vol. 42 July-August Nos. 7-8



FRONT COVER: When a section of Sign Route 49 (Mother Lode Highway) near Jacksonville, south of Sonora, was realigned and constructed to modern standards in 1957 a portion of the old highway was left in place to serve local property owners. In the spring, with wild flowers in bloom, it offers a particularly inviting rest or picnic stop. Entrance is available to southbound traffic only. Photo by Bill Ruland.

BACK COVER: Featured this issue is the Vincent Thomas Bridge between San Pedro and Terminal Island. This will be Southern California's first suspension bridge. When photograph was made spinning of cables had been completed and steel deck structure was being raised into place. Photo by Robert J. Rose, California Division of Highways.



CONTENTS

	Page
Freeways Are Safer Highways By J. C. Womack, State Highway Engineer	2
Napa River Bridge By G. D. Gilbert and A. E. Bacher, Senior Bridge Engineers, and R. L. Boulware, Associate Bridge Engineer	5
Highway Through History By Norman B. Deuel, Information Officer	11
Freeway Impact By Stuart L. Hill, Headquarters Right-of-way Agent	21
San Clemente Benefits From Freeway Project By Raymond F. Law, Information Officer, District VII	21
Negative Scribing By Joe Gage, Senior Delineator	32
Fill Settlement By R. F. Kocher, H. C. Chrisholm and G. A. Smith, Resident Engineers	35
District IV Develops Effective New Technique	41
National Highway Week	42
Lemoore Project By Thomas S. Ashley, District Advance Planning Engineer, and William L. Gilfillan, Resident Engineer	45
Aerial Inventory By Thomas N. Tamburri, Assistant Traffic Engineer	49
Permeability Test By Ernest Zube, Supervising Materials and Research Engineer	53
Twenty-five-year List	63
New Routes	64
District Library	68
Seven Promoted by Division of Architecture	69
District and Materials Conference	Inside Back Cover

Retirements

Retirement Claims 26	70	Ernest Sagehorn	70
Matthew Fredericksen	52	Harvey Smith	26
L. L. Funk	67	James Spence	67
Leonard Hollister	71	J. N. Stanley	69
N. C. McCorkle	63	Lyle Stanley	26
Norman C. Raab	66		

Obituaries

In Memoriam	67	Elbert C. Brown	71

LESTER S. KORITZ, *Editor*

STEWART MITCHELL, *Associate Editor* JOHN C. ROBINSON, *Associate Editor*

WILLIAM R. CHANEY, *Chief Photographer*

Editors are invited to use information contained herein and to request prints of any black and white photographs.

Address communications to: EDITOR,

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

P. O. Box 1499

Freeways Are Safer Highways

By J. C. WOMACK,
State Highway Engineer

Freeways are designed to carry large volumes of traffic expeditiously and safely. A freeway is a highway with all of the following characteristics:

1. There are separate roadways for traffic in opposite directions, and each roadway has two or more lanes.
2. Cross roads are separated in elevation from the freeway. There is no cross traffic, and no left-turning traffic, on a freeway.
3. There is no access between the highway and the roadside, except at specially designated entrance and exit roadways.
4. Traffic enters and leaves the main traffic stream at flat angles and at speeds near the speed of the main stream.
5. Curves are easy and grades are moderate.
6. There are no stop-and-go lights.

All of these features make it easier to drive and harder to have an accident on a freeway than on an ordinary road or street. Any highway that has all of these features is a freeway.

Most of the differences between freeways and conventional highways can be seen by comparing the accompanying photographs. Photo No. 1 shows U.S. 99 in South Sacramento where it intersected Fruitridge Road before the freeway was built. Photo No. 2 shows U.S. 99 where it intersects Fruitridge Road since the freeway was built. The traffic volume (vehicles per hour) is about the same as in Photo No. 1, although it does not look it. Photo No. 3 shows a cross road on a freeway where the plants have been in for a few years, and is more illustrative of the way a typical urban freeway looks.

Some persons have stated that freeways, such as those shown in Photos 2 and 3, are destructive of community values. In effect, they are stating that highways like the one shown in Photo 1 preserve community values.

However, certain community values, including life, limb, and property, are preserved by freeways to a much greater extent than they are by conventional highways. The freeway also does a better job of preserving the opportunity to visit and do business with other people in the area, conserving the cost of distributing food and the other things we buy, and conserving the amount of time it takes to go shopping or go to work in the morning. Furthermore, a freeway is the only kind of road that preserves the taxpayers' investment in the highway.

Why Freeways Are Safer

There is nothing mysterious about the reasons why freeways are so much safer than ordinary roads and streets. The characteristics that distinguish freeways from ordinary roads have a direct relationship to safety. Accidents happen in the following ways:

1. Cars collide headon when one of them crosses the centerline, or encroaches on the pavment reserved for cars going in the opposite direction.

Freeways have a "median" or divider strip which tremendously reduces the likelihood of crossing the centerline. The rate of headon collisions on undivided highways is 10 times as great as on freeways. The ratio is better than this on new freeways because the medians are wider and barriers are being erected on all the heavily traveled freeways where there is a likelihood of crossing the median.

2. Cars collide at right angles when one of them crosses the path of another at an intersection.

There is no cross traffic, nor left-turn traffic, on a freeway. In urban areas, intersections account for about two-thirds of all accidents on ordinary streets; even in rural areas, they account for 37 percent.

3. Cars collide when one of them makes a sudden turn into or from a driveway or parking space, and the driver of the other one doesn't see it in time.

HOW ACCIDENTS HAPPEN

1. Head-on collision.
2. Right-angle collision.
3. Collisions due to sudden turns into driveways.
4. Rear-end collision when fast car on highway collides with slow car entering or leaving.
5. Car spins off roadway, frequently on curve.
6. Car hits pedestrian in street.
7. Rear-end collision when car is stopped at signal.
8. Other rear-end collisions.

HOW FREEWAYS REDUCE ACCIDENTS

1. Opposing roadways are separated.
2. Separate levels—no cross traffic or left turns.
3. Access control—no private driveways.
4. Special slow-down and speed-up lanes.
5. Curves are easy.
6. Pedestrians cross under or over; fences.
7. No traffic signals.
8. Same rate on freeways.



PHOTO 1. U.S. 99 Stockton Boulevard at intersection with Fruitridge Road, 1960.

PHOTO 2. U.S. 99 freeway interchange at Fruitridge Road, 1963.



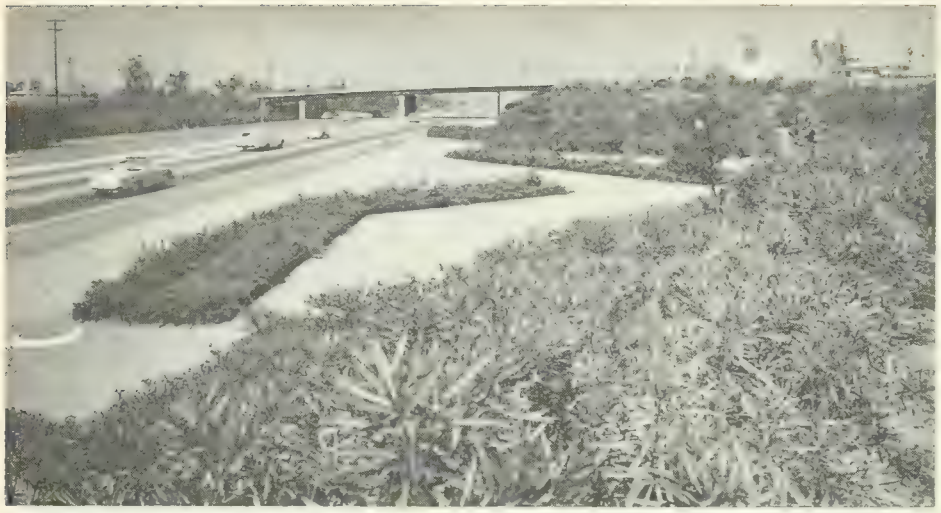


PHOTO 3. Freeway similar to Photo No. 2, but with mature roadside planting.

There are no driveways or parking stalls on freeways.

4. Cars collide when one slows down to turn into a cross street and the one behind it doesn't, or when one enters at low speed and the other, already on the highway, continues at high speed.

Freeways provide special slow-down lanes for cars leaving the traffic stream, and speed-up lanes for those entering the traffic stream.

5. Cars overturn or "spin" or drive off of the roadway all by themselves. Some investigators call these accidents "solos"; others call them "single vehicle accidents."

Freeway curves are easy and well marked; there are three times as many solo accidents per million vehicle-miles on ordinary rural state highways as there are on freeways. Even so, more than half of all fatal accidents on freeways are solos, which experienced drivers seldom have unless they indulge in foolhardy driving practices.

6. Cars strike pedestrians when pedestrians cross the street or play in the street.

Pedestrians cross freeways on overpasses, and freeways are fenced to prevent playing in them. It is illegal to hitchhike on freeways.

7. Cars run into the rear end of other cars waiting at a traffic signal.

There are no traffic signals on freeways.

8. Cars run into the rear end of other cars between intersections.

This is the one category of accidents that is just as likely to occur on freeways as it is on other roads, but statistics show that it is no *more* likely; the rate is just about the same.

Safety Record of Freeways

The preceding list of reasons why accidents happen more often on conventional roads and streets than they do on freeways is not theoretical; the facts, based on experience, bear them out: Freeways are much safer than their conventional counterparts in both rural and urban areas. Putting this into figures, the following statements can be made:

1. *Preservation of Property*

More than 130 accidents a day are being prevented by California freeways now in service.

The travel that took place on California freeways during 1961 would have generated 47,400 more accidents if it had taken place on conventional state highways in rural and urban areas. These 47,400 accidents that did not take place saved residents and guests of California millions of dollars in wrecked vehicles.

2. *Preservation of Limb*

More than 65 persons are saved from injury every day by California freeways.

A given amount of travel on urban area freeways produces less than one-third as many injury accidents as the same amount of travel on urban arterial highways. A given amount of travel on rural freeways produces one-half as many injury accidents as the same amount of travel on other rural state highways.

23,800 fewer persons were injured in California traffic accidents during 1961 than would have been injured if all the freeway travel had taken place on conventional roads and urban arterials.

3. *Preservation of Life*

Almost one life a day is being spared because of the freeways now operating in California.

In 1961 there were 306 fewer people killed in California traffic accidents than there would have been if all the travel then taking place on freeways had been obliged to use conventional highways and streets. This number will continue to grow in the future, because the freeway system is being expanded.

As shown in the chart on the following page, more than 2,000 lives have been saved since 1949 by California freeways.

* * *

In summary, a solid 14-year statistical record covering hundreds of thousands of accidents and billions of miles of travel shows conclusively that freeways are producing great savings in life, limb, and property.

Using California Traffic Safety Foundation values for accidents, California freeways in 1961 alone saved the motorist over $65,000,000.

Although these dollar values are large, they fade in comparison to the immense savings in anguish and human suffering that did not take place because of freeway development in California.

Construction Index Shows Slight Drop

The California Highway Construction Cost Index for the second quarter of 1963 dropped to 243.7 (1940 = 100) which is 6.7 points or 2.7 percent under the first quarter of 1963.

The average number of bidders for this quarter averages 5.3 per project, a decrease of 1.0 under the previous quarter.

Napa River Bridge

Substructure Contract Completed in April

By G. D. GILBERT AND A. E. BACHER, Senior Bridge Engineers, and
R. L. BOULWARE, Associate Bridge Engineer



The substructure contract for the replacement of the existing Napa River Bridge at Vallejo was completed in April 1963. This is part of the modernization of the familiar Sears Point Cutoff which was built as a private toll road in 1927, by the Sears Point Toll Road Company.

The existing structure at the site is a two-lane, low-level causeway with a bascule span over the shipping channel. It was originally built completely of timber except for the steel bascule span and has been a source of constant maintenance expenditure for several years. There has been an average of 92 bridge openings per month during the past three years with a maximum of 173 openings during August 1962. An average of 13,000 vehicles a day cross the bridge with especially heavy morning and evening peak-hour volumes due to proximity of Mare Island Naval Shipyard.

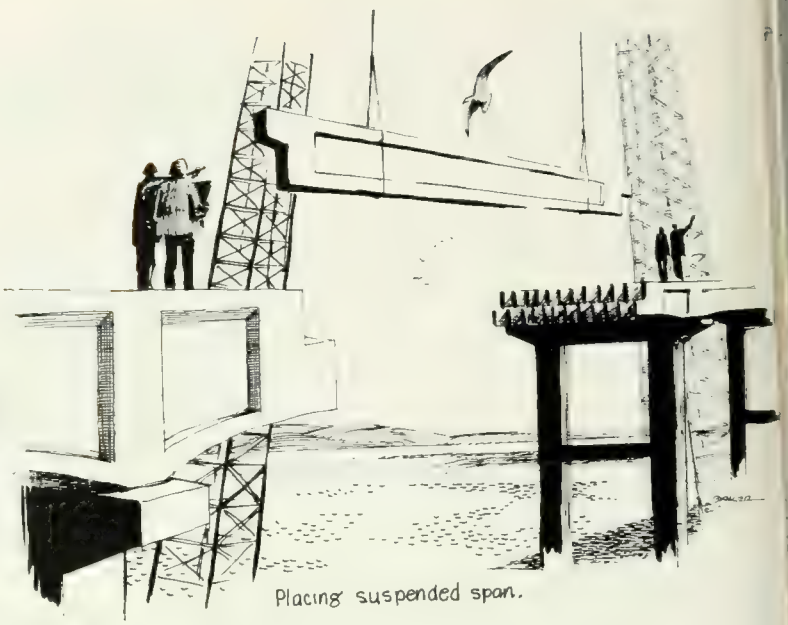
While river traffic is relatively light, tricky currents and a narrow opening (75 feet between fenders) at the channel span have resulted in frequent ramming of the existing structure by ships in the past. In the period of 1940-1954, a total of 45 collisions were recorded involving vessels striking the existing structure. Frequent heavy fog at the site is another complicating factor.

The replacement structure, a fixed high-level bridge over a navigation channel, will represent several innovations insofar as precast, prestressed concrete design is concerned for a highway structure in California; the use of 200-ton 54-inch prestressed concrete cylindrical piles, the precasting of portions of the piers, and the use of prestressed I-girders including a girder continuous over a pier support utilizing two-stage prestressing. Nearly all elements are designed as precast or prestressed concrete members.

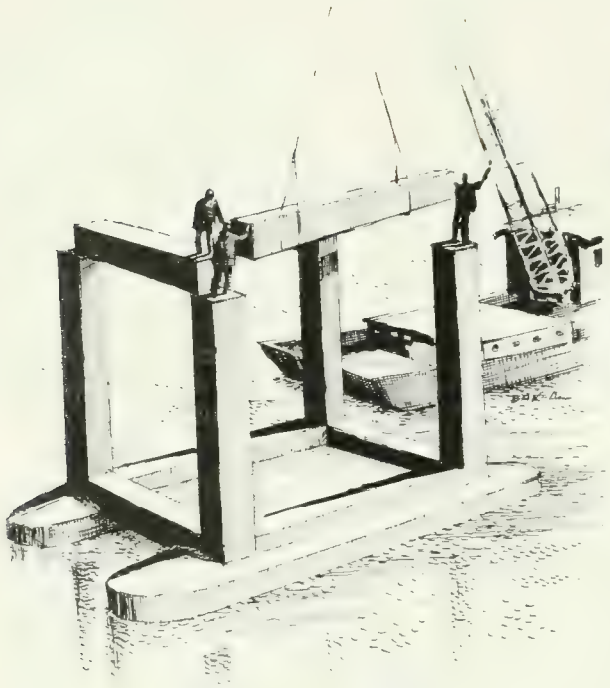
The channel is approximately 2,300 feet wide with a main navigation channel requiring 100-foot vertical clearance and 140-foot horizontal clearance. The total overall structure length is 3,280 feet, and it is 74 feet 4 inches wide, providing for four extra-width lanes of traffic, a 10-foot median, and a 5-foot sidewalk on the south side. The substructure contract included only the piers in the 2,300-foot channel and were constructed to the top of the footings only.



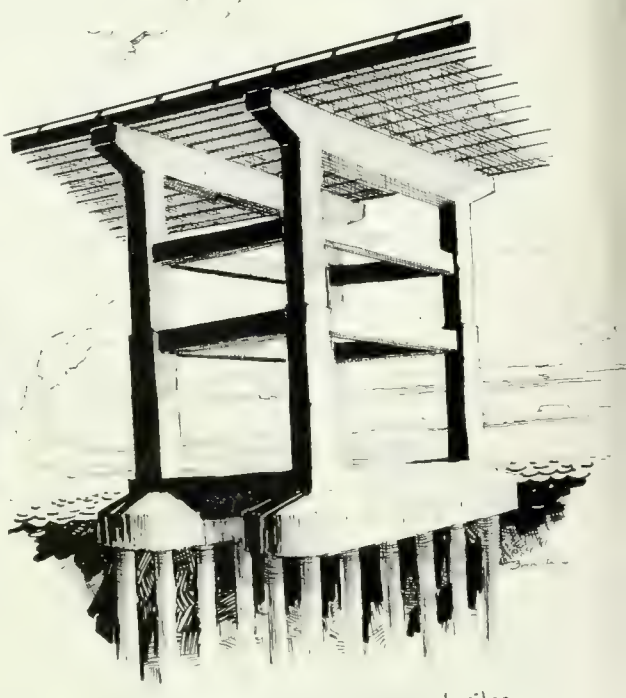
A 54-inch prestressed precast pile being placed. Note the jetting tower to the left of the pile.



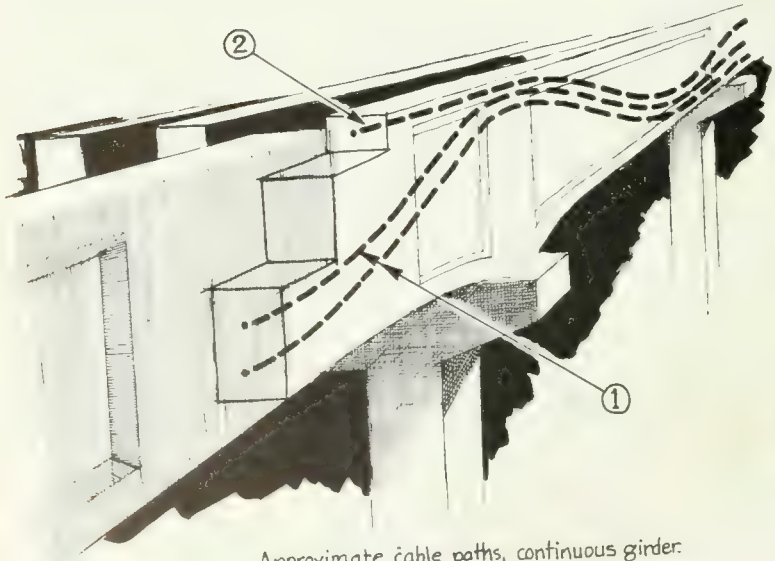
Placing suspended span.



Placing precast strut.



Tower showing 54" prestressed piles.



Approximate cable paths, continuous girder.
① 1 ST. STAGE PRESTRESSING
② 2 ND. STAGE PRESTRESSING



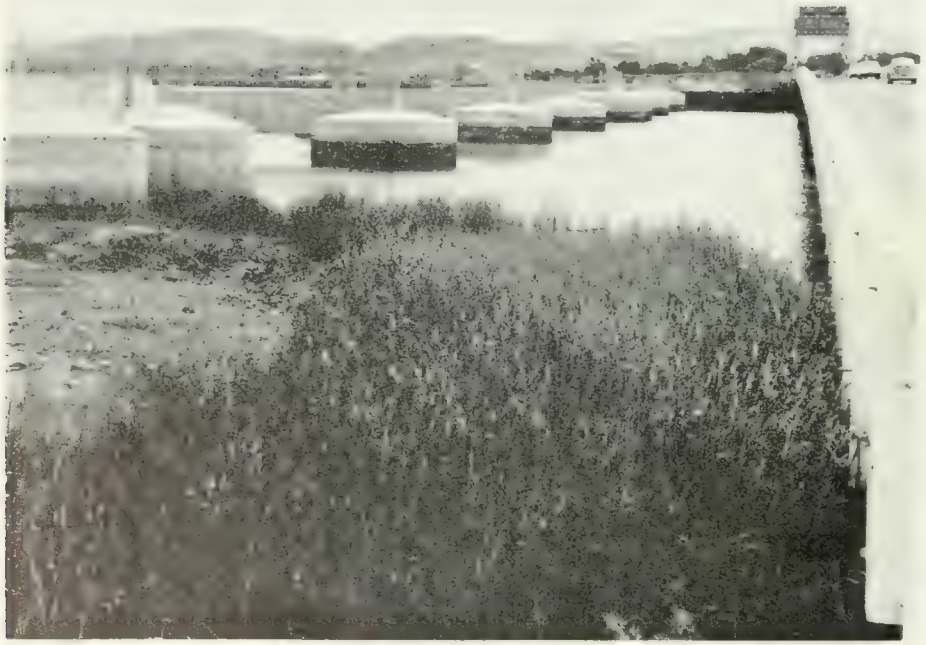
An aerial view of the project looking eastward. The substructure is to the left of the existing bridge. A portion of the Mare Island Shipyard can be seen right center.



This artist's sketch shows how the bridge will look after it is completed.



Steel forms used for casting the 54-inch pretensioned piles are being set prior to concrete placement.



Looking east from the shore of the Napa River channel. The existing bridge is at the right edge of the photo.

Construction

The site, near Vallejo, has extremely poor foundation material to a depth of 80 feet, consisting of very soft blue clay layers intermixed with silt layers. Site foundation conditions vary considerably. At the easterly end two piers are founded on spread footings at a relatively shallow depth. The bearing strata dip sharply to the west and by midriver are overlain by soft deposits up to 80 feet in depth. Under these conditions, it was necessary to use a pile new to California experience for the foundation of the river piers.

As with any major river crossing, numerous problems not encountered in ordinary highway and bridge work presented themselves. The expected problems were augmented by the site conditions and a six-foot daily normal tide.

The pile selected, although used previously in other states, is believed to be the largest driven pile ever used in California. The Contractor chose to use a pretensioned pile, though post-tensioning of precast units made by a centrifugal process was optional. It is a 54-inch OD prestressed cylinder with 5-inch walls designed to support a load of 200 tons. The maximum length used was 122.5 feet, and these piles weighed 49½ tons each. These piles are driven open ended 20 feet into the bearing strata. Each pier consists of two footings containing seven of these piles in each footing.

To test the validity of the design, a test pile contract was let in July of 1961. Under this contract, a test pile was driven and then loaded to 300 tons with the test load being held for 10 days. The results of this test were satisfactory and a contract for the substructure was let in March 1962.

Driving Piles Difficult

The driving of these large piles was, at best, difficult. The piles were set in a hole, prejetted through the soft upper layers to within 20 feet of the specified tip, and then driven the last 20 feet. A minimum of 30 minutes, and in some instances, as long as an hour was required to drive the piles to grade. The prejetting of the holes was in itself, a major operation.

The handling and positioning of these large piles took a relatively long



This photo shows the completed Tower 11 footings and struts.

ime. The total operation of position-
ng the jet tower, prejetting, lifting,
ositioning, setting and driving the
ile took from two to four hours. An
verage of 2½ piles in place per driv-
ng day was achieved. The pile-driv-
ng hammer used was a 24,000-pound
ifferential-acting hammer delivering
0,200 foot-pounds of energy per
low.

The contractor, Pomeroy-Gerwick,
abricated the 54-inch piles at their
etaluma plant and barged them to
ie site. The piles were cast three at
time in steel forms especially de-
gned by the contractor. External vi-
ators were attached to the steel
rms and proved very successful in
oviding a uniformly homogeneous
le section. After casting, the piles
ere steam cured for 24 hours. The
rms were then stripped and the piles
oved to a holding bed for additional
ater curing. By the end of the con-
act, the contractor was casting three
es every other working day with
e required concrete strength of
000 psi being achieved in about six
ys.

Footing Rings

At each footing, a footing ring extends downward 8½ feet from the bottom of footing. This places the bottom of the footing ring just below the estimated lowest low tide water surface. The footing itself is an 8-foot-thick cylinder placed on top of the 8½ footing ring, capped by a 2-foot-thick truncated cone and surmounted by a 3-foot-high column stub. A spandrel beam spans between the two footings. At low tide, the pier substructure presents a massive appearance. The four tower piers are even more massive and substantial in appearance.

The footing rings were designed to be either precast or cast in place at the contractor's option. He elected to use the precast option. These precast rings are used to enclose the piles and to provide a form to cast the piles, ring, and footing into one integral unit. To further reduce the open-water concrete placement the contractor also precast the spandrel beams.



Looking east at the substructure. Pier 15 is in the foreground.

The top four feet of the piles were filled with concrete. Since mean higher high water was approximately at the bottom of footing elevation it became necessary on a few occasions to place this concrete at night due to unfavorable tidal conditions during the day. The tower footing rings were placed in two sections with a tremie seal joint. Since the minimum tides always seem to arrive after dark, inspection of these joints usually required after-hours work.

The underlying material on the west bank of the river is very unstable. One survey hub set to establish the centerline of pier for the first pile driven on the west bank was found to have moved 0.9 foot after pile driving for that pier was completed. Fortunately, no survey hub was considered good for more than a few hours in this area.

Pier Location

In order to accurately establish the location of the various piers, a large quadrilateral was established prior to the beginning of the work. Since the west bank area was known to be unstable and the test pile was only approximately 250 feet from the west shore, the test pile was selected as an oversize survey "hub" for one corner of the quadrilateral. Another point was set on the bluffs overlooking the east shore, and the other two points were set some 2,000 feet upriver. One of these was on a dike on the west shore and the other on a point of a bend on the easterly shore. All sides of the quadrilateral were measured by geodimeter. In addition, several other survey and check points were established across the existing bridge. It is estimated that at least two man-months were saved by this procedure as compared to the more conventional triangulation procedures. From the basic points thus established, all piles were located by turning angles with a theodolite.

Inasmuch as it was frequently necessary to climb up onto a completed pier for survey purposes, the surveyors became accomplished at the art of securing a line to column dowels, 12 feet above the water at low tide, using a homemade grappling hook thrown from a rowboat. Since pile driving was stopped by only the worst weather, this was sometimes accomplished in a driving rain. Even the worst landlubber among the state forces became a reasonably competent small boat man before the work was completed.

Once the basic quadrilateral was established, triangulation was extensively employed. With the aid of the electronic computer, all of the necessary angles to set piles, center of footings, etc., from various points were rapidly and accurately precalculated. It is estimated that one more man, computing angles full time, would have been required if the electronic computer service had not been available.

Design

The Napa River channel is approximately 2,300 feet wide with extremely poor foundation conditions. Since large costly footings would be required to resist the longitudinal seismic forces, with conventional pier design, the alternative of connecting several spans to a single pier to resist the longitudinal forces of the combined spans was adopted. These piers were designated "towers" and are actually two piers, 30 feet apart, tied together by means of struts. Only five towers are required to resist all of the longitudinal seismic forces.

The footings of each bent are designed to carry the direct loads and are also capable of resisting the transverse forces that could result from an earthquake. The use of the 54-foot 200-ton piles provided a design that met the structural requirements for the unsupported pile of this length. The point of fixity of the piles was assumed to be 18 feet below the mud line or one-third the length of the pile below mud line, with the lesser length being used for design. Group I and VII loadings and unsupported lengths were the governing factors in the design of the piles.

The tower and pier details are detailed to provide for precasting the struts. The columns will be cast in place. Though consideration has been given to a precast alternative, the cap will be cast in place, since its size and weight precludes any satisfactory precast alternative. The forms for the cap can be supported on the strut beneath so that the construction of the cap should not pose any major construction problem.

West Extension Necessary

The extremely unstable conditions at the west end have necessitated a 300-foot structure extension of the westerly portion of the original design. Lightweight backfill material will be used at abutment 1 to reduce the backwall pressure on the abutment. At the present time there is an overburden of approximately 10 feet at abutment 1, placed under a previous district contract, which will further stabilize the material in this area. Hundred-ton pretensioned concrete piles will be used for structure support of this westerly portion of the bridge.

The superstructure details include spans of precast prestressed I-girders except for a small portion of cast in place T-beam at ramp A. The composite slab is being made continuous for live load over the pier supports. There are a total of 100 120-foot, 182 100-foot, 10 140-foot, and 20 144-foot precast prestressed girders, and 51 30-foot precast girders. The 20 144-foot girders, which carry the 140-foot suspended span, are being designed for two-stage prestressing. Since these 144-foot girders are continuous over a support, with a great variation in design conditions from the time of casting and initial stressing to the final design loading with live load, it was necessary to consider this sequential type of prestressing. The girders will be brought in by barge.

The combination of prestressed design concepts in the Napa River bridge is considered to be a good example of the use of prestressed design in bridge construction.

R. L. Boulware was resident engineer on the substructure contract. Design was under the supervision of G. D. Gilbert and A. E. Bacher.

The substructure cost was approximately $2,200,000. The superstructure will cost an additional $4,400,000 (estimated), and $1,300,000 will be required for construction of approaches and related work. The latter projects have not yet been included in the state highway budget, but if funds are made available they could be completed by some time in 1966.

Highway Through History



Route 49 Retains Scenic Quality as Construction Projects Make It Pleasanter and Safer to Travel

BY NORMAN DEUEL
Information Officer

Taken from south to north, as state highway routes are usually described, State Sign Route 49 stretches a sinuous, scenic and history-laden 289 miles from a junction in Mariposa with Sign Route 140, the all-year highway to Yosemite Park, to join U.S. Highway 40 Alternate at Vinton in Plumas County.

Technically, the route extends southward another 27 miles from Mariposa to a junction with Sign Route 41 at Oakhurst, Madera County. This section is now a county road (Boot Jack Road for the most part) and passes through such picturesquely named places as Nipinnawasee and Ahwahnee. It is not now signed or maintained by the State but eventually will become a part of Sign Route 49.

The number "49" was assigned to the route in 1933 in recognition of its historic significance in linking the mining camps of the Gold Rush days. The shield which carries the number (and the numbers of all state sign routes) is in the shape of a miner's spade.

Scenic in fact and mostly unspoiled by the burgeoning growth of California in population and motor vehicles, most of Sign Route 49 came under the protection of law by the enactment this year of Senate Bill 1467, creating a scenic highway system. This is "a program by the State for the development of a state scenic highway system [as] a vital part of the all-encompassing effort which the State must make to protect and enhance California's beauty, amenity, and quality of life." The bill was signed into law by Governor Brown on July 15.

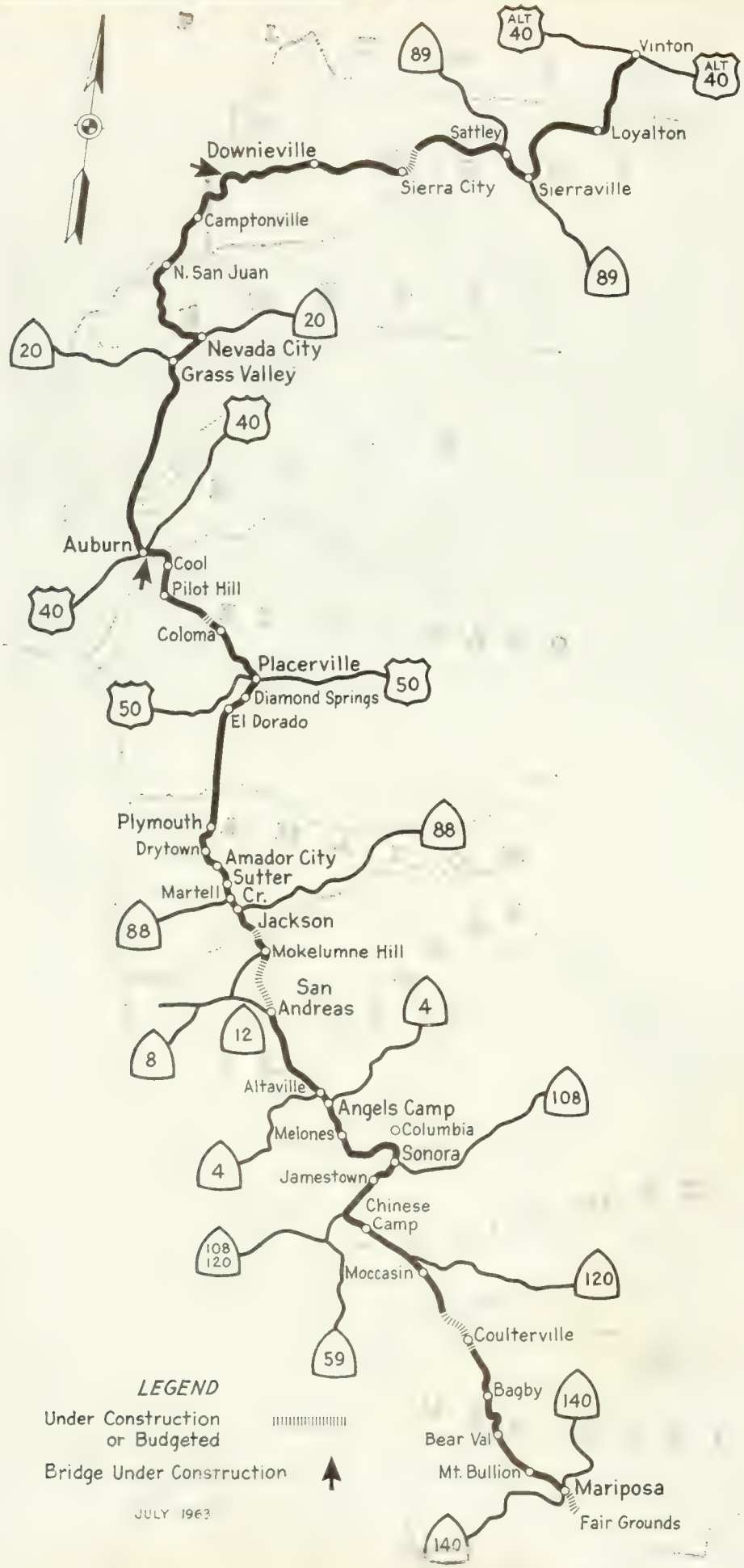
Portions of the highway, from Jackson to Placerville, and from Auburn northward are also on the California freeway and expressway system. This presents no conflict with the concept of a scenic highway, and in fact is an added factor of protection.

Traffic needs do not require, nor would terrain for the most part permit, the development of a fast multilane highway over most of the route. The only plans for full freeway construction are now under consideration only for some of the more heavily traveled sections, such as the highway between Grass Valley and Nevada City. Freeway designation at other locations will be used only to restrict unsafe access to a modern two-lane highway and control the location of roadside business entrances in the interest of safety, although there will be a moderate amount of four-lane construction.

Connects Gold Rush Towns

Sign Route 49 connects almost all of the historic Gold Rush communities. In its course it traverses a landscape unsurpassed in variety. Its face changes with the seasons and it can be hot in summer and cool and rainy in the winter, but never very cold except in such a location as Yuba Pass at an elevation of 6,701 feet.

North of Mariposa on Bagby Grade it clings to the sides of the hills, overlooking precipitous brush-covered canyons, winding through switchbacks. The road here is surfaced but narrow, steep and winding. But driven with care it is safe, and traffic is light.



There are little valleys in the foothills, too, where sheep and cattle graze in season when the grass is green. During this time wildflowers are plentiful on the hillsides. Farther north is evergreen country of pines and firs, more canyons and swift-flowing streams.

The highway crosses all of the important rivers draining the Sierra Nevada Mountains—the Merced, Tuolumne, Cosumnes, American, Bear and Yuba Rivers.

In these areas it is an up-and-down highway. One engineer wrote in *California Highways and Public Works*, January-February 1953:

"Indeed, the highway may be described as consisting of an alternating series of stream crossings and ridge crossings. Across one river—up the opposite ridge and down the other side—up a second ridge and down again—and so on. At times the motorist may believe the distance he is traveling up and down exceeds that in the horizontal direction. Many of the rivers are in deep canyons, and the problem of road building is made more difficult because heavy mountain-type construction is often necessary."

Hydroelectric Development

The abundance of water has brought hydroelectric development, some of which is visible from the highway and nearly all of which affects the plans of the highway builder.

Sign Route 49 passes the Moccasin Creek power plant of San Francisco's Hetch Hetchy water supply system and at Melones crosses the upper arm of the reservoir formed behind Melones Dam on the Stanislaus River.

The highway links the communities of the southern mines, Coulterville, Sonora, Columbia (just off the route), Angels Camp, San Andreas, Jackson and Sutter Creek; and Placerville, Coloma, Auburn, Grass Valley, Nevada City and Downieville of the northern mines.

Now a recreational pursuit for the occasional weekend or vacationing gold panner, mining as a major endeavor ceased many years ago. But in many communities signs proclaim that if the price of gold were raised it would become again a profitable industry.



In Mariposa near Highway 49 is the oldest courthouse in continuous use in California. It was built in 1854, and is still functioning.



Bagby Grade, north of Mariposa, offers spectacular views of brushclad canyons where the driver must negotiate grades and switchbacks. Some lookout points are provided



An ancient locomotive once used in the Mary Harrison mine seems to have a pensive regard for evidence of more modern transportation as it overlooks construction for relocation of Sign Route 49 near Coulterville.

There still remains the evidence of past intense activity. Near Sutter Creek, Amador City and Jackson the tipples of deep hard rock mining may be seen. Along miles of the highway near streams are the gravel beds upturned for placer mining and between Camptonville and Downieville is the canyonlike remnant of the Depot Hill hydraulic mine.

The evolution of what is now Sign Route 49 is obscure in its early days. But we can be sure that a trail, first blazed by men afoot and on horseback, linked what were the most important producers of California's wealth more than 100 years ago.

Its development into a wagon road came slowly but surely. Records show that as recently as 1905 there were relatively few miles of county roads clearly developed as such in the vari-

ous counties of the State. Right-of-way was seldom definite, and property owners were apt to shift the roads to suit their purposes.

1909 Bond Issue

Development of Sign Route 49 as a state highway can be more definitely documented. The start came in 1909 when the Legislature authorized a bond issue of $18,000,000 to start a state highway system which would link the various county seats and integrate road transportation in California.

Largest segment of Sign Route 49 to become a state highway and eligible for improvement with proceeds of the 1909 bond issue was that between Auburn and Downieville. Another was from Mountain Pass, near Chinese Camp, to Sonora.

In 1921 the Legislature made part of the state highway system that section of the highway from Auburn to Sonora through Placerville, Jackson, San Andreas and Angels Camp and named it the Mother Lode Highway. That name has since been applied commonly to all of Sign Route 49.

Other sections of the road were brought into the state highway system in 1921 and 1929. In 1953 the segment from Sierraville to Vinton was added, upon completion of its construction by Sierra and Plumas Counties; and in 1959 the southerly extension to Oakhurst was put in on a "future" basis.

Recent Construction

Improvement of Sign Route 49 as a state highway was necessarily slow in the early years but with gradually increasing funds available many important changes in the highway have taken place. Construction has been limited mostly to short sections of the highway to improve narrow portions, ease steep grades and sharp curves, or to remove bottlenecks through such historic towns as San Andreas and Jackson without altering their character. A traveler who revisited the highway after a lapse of, say, 10 years would find the changes striking. Certainly he would find it safer.

During the last five years there have been several important projects in Mariposa County. A modern two-lane highway was built from just north of Mariposa to Bear Valley at a cost of $1,100,000. This was completed in 1960. Portions between Bear Valley and Coulterville were improved in stages between 1958 and 1961 at a cost of $275,000.

In El Dorado County the highway was realigned in 1960 for 2.4 miles from 0.2 mile north of Pilot Hill to 1.0 mile north of Hastings Creek at a cost of $186,300. In 1962 the realignment work was extended south for 1.6 miles and a new bridge built across Hastings Creek at a cost of $353,900; and in the same year realignment was continued to 0.9 mile south of Greenwood Creek, a distance of two miles.

In 1961 the Bear River bridge on the Placer-Nevada county line was re-

The sign "Eagle Cotage" [sic] at Columbia State Park is not mispelled. It means that cots once were available there for miners. At the left is the rebuilt Masonic Hall, used on occasion by lodges throughout the State. The original building was destroyed by fire.



Sign Route 49 offers an occasional stretch of straight highway through oak-studded countryside. This scene is near Jacksonville in Tuolumne County.





Sign Route 49 once made right-angle turns through the crowded main street of Jackson above. Now a bypass a few hundred yards away provides free-flowing traffic (below).



placed on new alignment at a cost of $237,000.

In Nevada County, 1958 saw the construction of a two-lane expressway for 7.3 miles from the Bear River (Placer county line) to 1.5 miles south of Rattlesnake Creek.

In Sierra County in 1961 and 1962 the highway was reconstructed or resurfaced for 10 miles between Sierraville and Loyalton at a cost of $214,000. A bridge was replaced in Sierraville in 1962 at a cost of $50,000.

Current Construction

A start on improvement of the road south of Mariposa is underway with a federal aid secondary project for grading and base between Mariposa and the county fairgrounds at a cost of $302,000.

Six and a half miles of the highway between 1.5 miles south of Coulterville, and the Tuolumne county line is being relocated at a cost of $1,055,000, with completion of grading and paving scheduled for the end of this year.

The first stage of relocating the highway between Sign Route 12 and Mokelumne Hill, grading and the construction of two bridges, is underway at a cost of $1,210,000.

Bids were opened May 29 for the new east Auburn underpass, including



Relocation of Sign Route 49 in the vicinity of Sutter Creek is under study to relieve traffic congestion without affecting the historic buildings along the principal street.



The highway has been made safer by channelization and widening of once hazardous intersections. This is the intersection of Sign Routes 49 and 16 north of Drytown, Amador County.



Coloma State Park preserves ancient buildings erected following James Marshall's discovery of gold in the American River in 1848. There are picnic facilities and pleasant spots in sun or shade. Highway 49 is just beyond the rustic fence.



A new bridge over Hastings Creek and a section of realigned modern two-lane highway north of Coloma were completed in 1962.

0.2 mile of four-lane highway, with the low bidder offering to do the work for $266,511.

Reconstruction is underway between 0.8 mile south of Greenwood Creek and 0.4 mile north of the South Branch of the American River, a distance of 1.4 miles. The contract is for $97,460 and the estimated completion date is this fall.

A new bridge over the North Fork of the Yuba River in Sierra County, plus new approaches on new alignment will cost $242,195, but probably will not be completed this year. Traffic meanwhile is using a temporary structure which was built at a cost of $35,500 as a temporary substitute for the flood-damaged old bridge.

The biggest contract, for $1,388,640, in the northern sector of Sign Route 49, is for 3.9 miles of two-lane expressway between 0.7 mile east of Sierra City and Bassetts. This could be completed late this year, depending on weather.

Projects Budgeted

Amador County—Reconstruct and widen between Calaveras county line and 1.3 miles north, $850,000. (Bid opening July 24.)



A section of modern two-lane expressway speeds the traveler between Auburn and Grass Valley.



North of Nevada City the highway crosses the gorge of the South Fork of the Yuba River and rises again beyond the tumbling waters.



Sign Route 49 passes through rugged country between Sierra City and Bassetts, where 3.9 miles of two-lane expressway is under construction. It will cost $1,388,640.



Downieville, the county seat of Sierra County, nestles along the Yuba River and was named after the leader of the first gold discovery party in the county.

Calaveras County—Pave between Sign Route 12 north of San Andreas and Mokelumne Hill, 6.5 miles, $600,000. (Bid opening August 21.)

Nevada County—Widen portions between 1.5 miles north of the South Fork of the Yuba River and North San Juan, $50,000.

Sierra County—Widen portions between Bassetts and Yuba Pass, $100,000.

Planning for the Future

The specific location of Sign Route 49 has been determined by the Highway Commission for the major portion of the highway between the Mariposa county line and Yosemite Junction, which will require realignment due to the construction of the Don Pedro Dam. Actual development of detailed design on this section of road depends upon an agreement to be entered into with the irrigation districts as soon as their plans for Don Pedro Dam have been accepted by other agencies.

Between Sonora and San Andreas realignment in the vicinity of Melones Dam depends on final decision regarding dam construction.

A recommendation for a route relocation in the vicinity of Sutter Creek has been submitted to the State Highway Commission, and the commission has held a public hearing on the matter. It is still under consideration.

Preliminary planning is underway on the section between Central House and the El Dorado county line. The final location depends on the construction of the proposed Nashville Dam.

The final location in El Dorado County, from the Amador county line to about six miles north, is also contingent on construction of the Nashville Dam. From that point north to the American River near Coloma, route studies have been made and a public hearing held.

Another dam construction problem affects the route between Cool and Auburn in El Dorado and Placer Counties, where future route adoption and construction are contingent on a firm

. . . *Continued on page 52*

Freeway Impact

Santa Ana Project Saves Users $7,000,000 in 5 Years

By STUART L. HILL, Headquarters Right-of-Way Agent

[Editor's Note: This article is a reprint of a talk given by Mr. Hill before the Associated Chambers of Commerce of Orange County on April 18, 1963, in Santa Ana. Data of this nature are gathered continuously by the Right of Way Department as a part of route planning and as vital information to the real estate appraisal process.]



I can point right now to any individual in this room and say, "You live within four miles of the Santa Ana Freeway." My chances of being correct would be better than 60 percent—because that's the percentage of

SAN CLEMENTE BENEFITS FROM FREEWAY PROJECT

By RAYMOND F. LAW, Information Officer, District VII

San Clemente, a seaside town of 11,000 population midway between Los Angeles and San Diego, is known to all who have traveled the Pacific Coast Highway along the coastline of Southern California. It is a convenient place to break a journey for fuel, refreshments or a visit to the beach.

The community's great natural assets are its climate, the quiet beauty of the Santa Rosita Hills sloping down to the Pacific, and beaches where swimming, fishing and surfing are at their best. Just north of the city is Doheny Beach State Park, and at the southern end is San Clemente Beach State Park. This environment, which led to the town's founding, has shaped the course of its development as a quiet residential community.

Before the San Diego Freeway (Interstate 5) was completed through San Clemente late in 1960, some residents expressed apprehension as to the effect

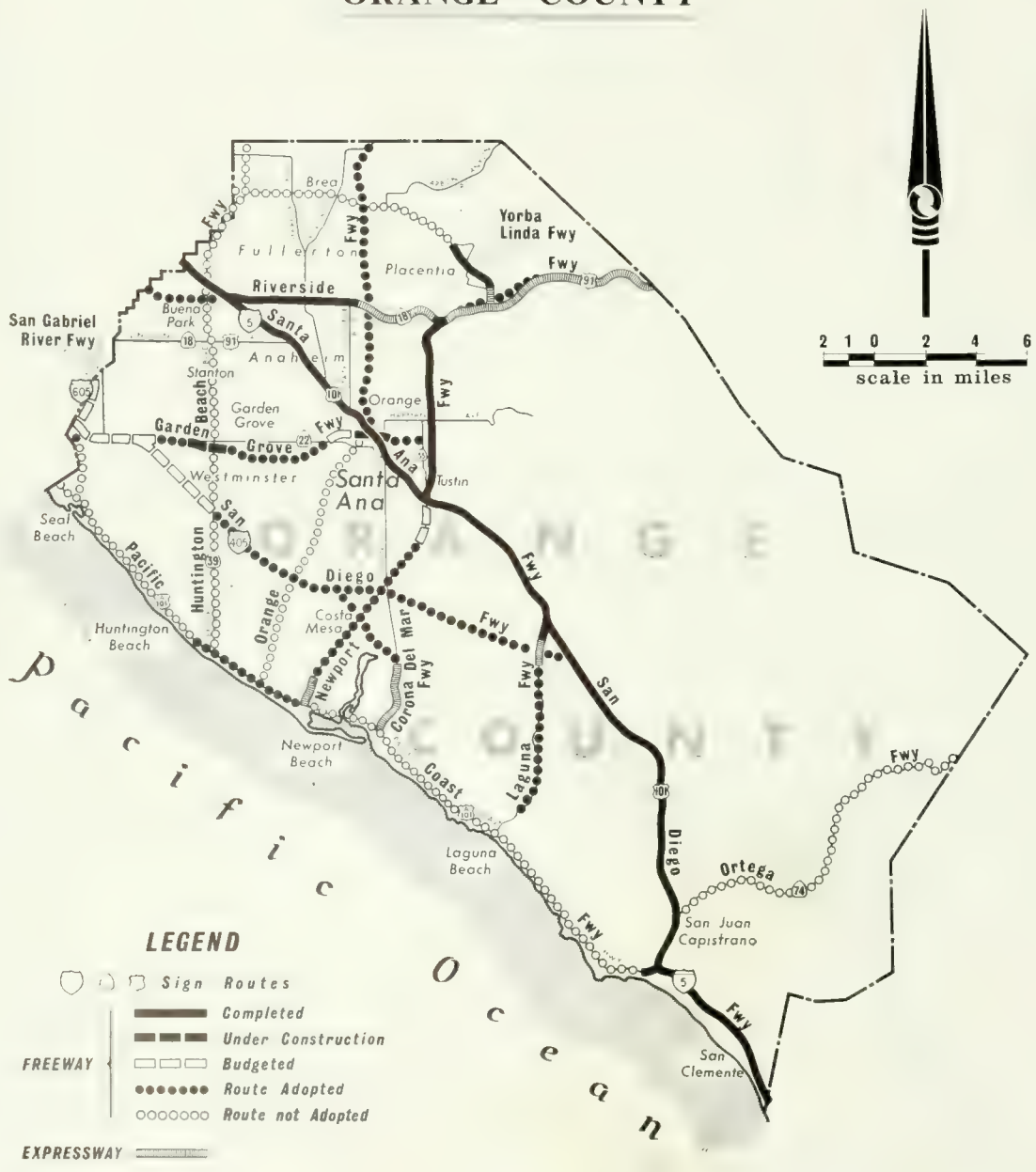
. . . Continued on page 27

PHOTO BELOW. Santa Ana-Garden Grove Freeways interchange. Garden Grove Freeway under construction. Santa Ana Freeway running diagonally across picture. Bullock's—Fashion Square is located to the right and the Union Bank Building to the left of the Garden Grove Freeway.



CALIFORNIA FREEWAY AND EXPRESSWAY SYSTEM

ORANGE COUNTY



county residents who live within that distance.

The Santa Ana Freeway cost the taxpayers of California $35 million. Since the opening of the Irvine Grade Separation in 1958 this freeway has saved the traveling public over $7 million in transportation costs. The average person commuting from Santa Ana to Los Angeles saves more than $50 every year.

This is one of the primary reasons that the freeway was built in the first place—to reduce transportation costs. Freeways are a means of helping free enterprise cope with the fantastic expansion that is being required of it. Our competitive economy is founded on the basic idea of constantly improving our products—of lessening the economic costs of production and distribution of goods and services.

The objective of a highway improvement is the same. The $50 saving the commuter realizes is called a "user-benefit," and his saving plays an important role in the location of freeways.

Other Benefits

However, the reduction of transportation costs has other benefits. For example, take the case of a merchant located near a new freeway in the suburbs. The freeway reduces the cost of delivery to his store, since a competitive trucking industry will pass on any savings it makes to the merchant. The merchant, in turn, improves his competitive position since he can sell more gods at less cost. The trucker's "user-benefit," then, is ultimately reflected in the increased business activity of the merchant and lower prices to the consumer. This effect is defined as a "nonuser benefit."

There are other, more far-reaching effects, however. The freeway is not merely a ribbon of concrete running across a former orange grove so someone else in Los Angeles can save time and money going to Newport Beach. The freeway—any transportation system—is an integral part of the local, regional and national economy. Almost all economic activity today is predicated upon the cost of distributing goods.

Let's say, for example, in a hypothetical community that, for any piece of property to be developed industrially, transportation costs dictate that the plant must be located within three miles or ten minutes from the central business district. You want to locate a plant in this community. You find that there are only ten parcels of vacant land available for what you can afford within that time-distance requirement.



Newport Freeway (Chapman Avenue in foreground), showing residential development.

But now a freeway is constructed. Suddenly, property five miles from the central business district is only ten minutes away. What happens? The value of the property five miles away suddenly increases. Its use has changed. Whereas before, it was farmland, or residential, it can now be used for industry. The reduction of transportation costs by freeway construction increases the supply of land which is available with certain time-distance requirements. It increases the value of the land in the suburbs through a change in potential use.

Impact and Change

This is impact. Impact is a change; generally a change in the economic activity of the area. This is the impact of freeways on Orange County. By reducing transportation costs—the time-distance ratio—rural property has become available for urban uses. This, too, is a "nonuser benefit."

But—let's look a little further. In this community, where before there were ten parcels of land available, there are now twenty. Twenty parcels of land competing for the same market. If you double the supply and not the demand, you certainly aren't increasing the aggregate value of all *twenty* parcels. The owners of the first ten parcels may have to reduce their asking price. So, maybe, despite an increase of land value in the suburbs,

there is actually a decrease in aggregate land values.

This would be good for the buyer—but not so good for the ten original sellers.

But the community we have described is theoretical. This effect is logical—but it isn't real. It doesn't happen like that. Land values in Los Angeles have *not* been decreasing to compensate for the increase in values in Orange County. The supply of land for specific uses has increased—but so has the demand.

Insatiable Demand

The insatiable demand for urban land in Southern California during the past 20 years characterizes the socio-economic changes that have been taking place.

Thirteen years ago Orange County had no freeways—little manufacturing—few cars—no Disneyland. Less than 200,000 people lived here then. Taxable retail sales in the county were about $200 million per year.

Today there are nearly 60 miles of freeways in the county. Retail sales, last year, probably exceeded one *billion* dollars, and 900,000 people live here. In just a few years both population and retail sales have increased nearly five times. Today, among *all* counties in the United States, Orange County ranks 22d in automobile registration. And, best of all, today you have Disneyland. In 1955, when Disneyland opened, taxable retail sales made their biggest percentage jump of the decade.

Was all this possible without the Santa Ana Freeway? Yes, of course. The freeway, itself, didn't cause these changes. But, they really weren't possible on the same scale, under the same conditions and in the same short period of time. Most of you have made many of your past decisions based upon the freeway's existence. Without it, you really wouldn't be doing the same things you are today. Accessibility—transportation was a key consideration when the location of Disneyland was determined.

I am sure you're all familiar with that old saw—if you build a better mousetrap, the world will beat a path to your door. The Santa Ana Freeway is like that better mousetrap.

Attracts Shoppers

Nearly 50 percent of all retail business in Santa Ana comes from at least 20 miles away. A prominent businessman in this community told me that shoppers come from as far away as San Diego to shop at Fashion Square. That's because of the freeway—or because the freeway has relieved congestion on secondary roads.

Every Sunday, the Los Angeles newspapers carry ads describing new subdivisions in Orange County. First they are described in terms of accessibility.

The growth of Orange County in the last few years has been almost directly dependent upon the Santa Ana Freeway. People followed the freeways out of Los Angeles into the county. But the freeway wasn't built with a deliberate intent of having some sort of impact on Orange County. It really wasn't built *for* Walt Disney, as a sort of driveway to Tomorrowland. The growth of Orange County in the last few years is a result of population pressures and of economic pressures, exploding out of Los Angeles, funneled down the Santa Ana Freeway and into Orange County.

The impact of freeways on Orange County then depends upon extraneous factors—events that take place outside of the county. In the past 13 years 6½ million people have been added to the population of California. Two and one-half million of them in Los Angeles County. Freeway construction has just barely kept pace with the population expansion and the demand for improved transportation facilities.

The freeway opened the door for the urbanization of Orange County; people flooded in; industry and commerce followed, and the demand for land kept pace with the increasing supply. In the hypothetical community where before there was only one bidder for the twenty parcels, there are now two, three or four.

Future Acceleration

But we can't confine impact to a point of time. The changes that have been going on in the past may be accelerated in the future. By understanding some of the characteristics of freeway impact we can peek into the future—say, 1980. Anticipating future changes is the only way sound business decisions can be made.

By 1980 there will be 65 million more Americans than today; a total of 245 million. Eleven million will be crowded into the Los Angeles metropolitan area—which includes Orange County. Orange County's population will triple; it will be some place between 2 and 2½ million. There will be as many people in the Orange County of 1980 as there were in Los Angeles County in 1940. Nearly 2 percent of all the suburban dwellers in the entire nation will be living in Orange County.

Today the county has a population density of 795 persons per square mile. In 1980, there will be over 3,000 per square mile. In 1960 the average density of *all* urbanized areas in the nation was 3,750 persons per square mile. Fullerton, Anaheim, Buena Park and Santa Ana, in 1980, will have densities of over 7,*000* persons per square mile. Nearly all of the usable land in the county will be urbanized.

If you, at this moment, feel inclined to say Stop! Stop! Who needs all the people? I would like to call two things to your attention. First, somehow—in a manner that seems incomprehensible, historically, population increases are always associated with either the development of "civilization" or significant advances in technology. There seems to be some relationship between our rapid advances in technology and our anticipated population increase. The addition of 65 million people in the United States by 1980 seems to be inexorable—we can't stop it. These people must be absorbed someplace—they must have jobs, housing, schools.

One Look Will Convince

Second, if you really feel like putting barricades around the county, visit someplace in the country where there is no growth. There are several states in the United States, indeed there are several counties in California, where population is declining—the youth are migrating—the economy is faltering or is stagnant. One look will convince you that standing still is not an acceptable alternative to the pains



Disneyland, showing relationship with Santa Ana Freeway.

of growth. Especially when growth does bring with it economic prosperity.

The State Legislature and the Division of Highways has been making plans for 1980 since before 1960—not only for Orange County—but for the entire State.

If all freeway construction in Orange County were to stop now—and no new freeways were to be constructed before 1980, the Santa Ana Freeway would become a hopeless snarl. All of the transportations savings—the user-benefits—and a great deal of the nonuser-benefits would be lost. For example, today on the Harbor Freeway at the four-level interchange the traffic exceeds 200,000 cars per day. At the Eighth Street offramp it is 175,000 cars per day. The Harbor Freeway is, as you know, an eight-lane freeway in the downtown area.

If no other freeways were built in Orange County, in 1980 traffic on the Santa Ana Freeway—*a six-lane freeway*— would be 150,000 cars per day—clear down to Anaheim. Harbor Boulevard—a four-lane road—could be carrying as many as 70,000 cars per day. The Pacific Coast Highway would be worse. Traffic *throughout* Orange County would resemble traffic in downtown Los Angeles during the peak rush hours. This county would be slowly strangled by traffic. The industry and commerce that moved into the county during the 50's and 60's could be expected to move away in the 80's. People who commute to Los Angeles to work would be forced to move out or face a drive of over four hours each day. Eventually, perhaps, some equilibrium could be reached—but in the meantime, home owners and businessmen would have lost tremendous sums of money as the value of their investments declined in direct proportion to the exodus.

Picture Is Conjectural

This gloomy picture is, of course, purely conjectural. It won't happen. The State Legislature, several years age, adopted the statewide master plan for state highways and planned 14 freeways for Orange County. The Santa Ana Freeway is but a part of an integrated, interdependent transportation system. This system, not individual freeways, is the most important factor in the future of Orange County. Without it, the county will strangle; with it, other growth plans in the county become feasible.

There are 14 freeways planned—with a total length of nearly 250 miles. Sixty miles of freeways and 20 miles of expressway are now built. To date the Division of Highways has spent $140 million in the county on freeways. By 1980 the figure will exceed $670 million. This does not mean, however, that there will be wall-to-wall concrete in Orange County. This system will take up *less than* 2 percent of the county's land area and it will provide for a more intensive development of the remaining 98 percent.

The most significant impact of freeways—as we described—is the suburbanization of industry and commerce. Not only in Orange County but all over California and the United States. Through a more efficient transportation system industry and commerce have burst the bonds that held them to the central city. When plants become obsolete it is economically feasible to relocate them in the suburbs. The improvement of the transportation system also has meant that labor has become more mobile—the location of a plant in the immediate vicinity of the labor market no longer is an absolute necessity.

Parking Areas Provided

In the suburbs industry and commerce spread out and provide large parking areas for people who have become willing to drive some distance to these facilities.

In 1980, industry will take up over 35 square miles of the county's land. Today they use six square miles. There will be at least 165,000 people employed in manufacturing in 1980. Today, there are 50,000. Besides the defense-oriented industries, the county offers excellent growth potential in fabricated metal products, machinery and electrical products, chemicals, drugs and allied industries, textiles and apparels, paper and allied products and boat building. The greatest industrial expansion will undoubtedly be along the coast from the Irvine Ranch to

Huntington Beach, Westminster and Seal Beach—more or less along the San Diego Freeway.

Annual retail sales in 1980 will be nearly $6 *billion* compared with the $1 billion of today. Four hundred thousand persons will be engaged in commercial enterprises. Today, there are 70,000. Instead of 20 square miles devoted to commerce, there will be 80 square miles. Tourism will contribute its share to the county's growth—the annual income from tourism will increase from $100 million today to $300 million in 1980. As the county economy expands, the county will become more and more self-sufficient. Trade and finance activities will find it more profitable to locate here—in proximity to the markets which they hope to serve. A much larger percentage of the residents will be working in the county, and the tendency to buy goods outside the county will be greatly lessened.

Without the past industrial and commercial expansion, many of the improvements made in county services and facilities would have been impossible—flood control, schools, libraries. A bedroom community does not provide a tax base which is adequate for the development of the community unless tax rates are prohibitive. Lacking further industrial and commercial expansion, Orange County could, in 20 years, become a giant slum—with wholly inadequate police, fire and educational facilities.

1980 Projection

The industrial and commercial expansion that I have projected for 1980 is hypothetical. But it *can* happen. The freeway system provides part of the basic requirement for it to happen. But it is even more essential for the community to create the basic environment that will attract that industry and commerce.

Therefore, when we discuss the impact of freeways in Orange County, we are really talking about a freeway system that is yet to be. We are really talking about the future suburbanization of industry and commerce. Hughes, North American, The Broadway, Fashion Square, to name the more obvious, are just the forerunners of tomorrow. Many much smaller, and even some larger, enterprises will find themselves in Orange County tomorrow because of the freeway system.

It is characteristic of our economy—our civilization—that everything is mutually interdependent. You can single out many individual factors as primarily responsible for our present condition.

The other night, for example, on TV there was a short commercial on plumbing facilities. Think, they said, of where we would be today without modern plumbing facilities.

The whole structure of our civilization is built upon a network of interdependencies such as this. Freeways are just one of the essential ingredients. They have impact—or benefit—far beyond their original intention because of the interrelationship with the rest of our economy.

Earlier, I said that the Santa Ana Freeway was not really Walt Disney's driveway to Tomorrowland. It isn't. The freeway system is *Orange County's* driveway to Tomorrowland.

The freeway system is one of your economic tools—just the same as a lathe, a good foreman, an advertising sign. It is up to you to use that tool in the most efficient manner.

Today, we are planning for 1980. Are you?

Maintenance Super Retires in Fresno

After serving the State Division of Highways for 30 years, Lyle Stanley, maintenance superintendent in District VI, retired on June 28, having held his present position since 1950.


LYLE STANLEY

A native of Missouri, he came to California at the age of 10 and attended school in Sanger. His working years began at age 16, and included experience with a lumber company, as a mixerman, pipemaker, truckdriver, and road work foreman for Fresno County. When he began work with the Division of Highways—District VI—in 1933, he worked as a grader operator. In 1938 he was promoted to bridge foreman, in 1950 to highway maintenance superintendent.

Principal highways over which Stanley had maintenance jurisdiction are State Sign Route 41 north of Fresno to the Yosemite Park boundary; U. S. 99 north of Fresno to the Merced county line, and State Sign Route 180 west of Fresno to Dos Palos.

Right-of-way Agent Harvey Smith Retires

Harvey B. Smith, supervising right-of-way agent in District IV, retired on August 30 after a career of 32 years in public service, 18 of which were with the Division of Highways in San Francisco.


HARVEY B. SMITH

Smith was born and brought up in Hope, North Dakota. In the fall of 1917 he moved with his family to Inglewood in Southern California where he graduated from high school. He attended the University of California at Los Angeles, and after a period of private employment he started in public service with the County of Los Angeles.

In 1942 Smith enlisted in the Army. He began his right-of-way career with the State in October 1945 when he was appointed assistant right-of-way agent in District IV. Since then he has held various positions in the district right-of-way section, including 14 years in charge of the appraisal department, and at the time of his retirement was supervising right-of-way agent—administration.

CONFERENCE ANNOUNCED

The sixteenth California Street and Highway Conference has been scheduled for January 30-February 1, 1964, on the Berkeley campus of the University of California. Announcement came from the university's institute of transportation and traffic engineering, which annually sponsors the conference for state, city and county engineers.

SAN CLEMENTE

Continued from page 21

it would have on their way of life. They were interested in preserving the town as a good place to live and in maintaining businesses devoted largely to serving the motoring public.

Now, nearly three years later, it is clear that the community has benefited from improved transportation. The freeway has been responsible in large measure for a great expansion in home building as more and more people have decided to live in San Clemente and drive to work in Santa Ana, 26 miles away, and other industrial centers of Orange County. Business is generally better, a new civic center on the hillside overlooking the ocean was occupied last December, and travel on city streets is easier and safer with through traffic moving on the freeway.

City Founded in 1925

San Clemente was founded in 1925 by Ole Hansen, a successful real estate developer from Seattle, who envisioned a quiet village with Spanish atmosphere where he and other retired persons could "view the sea from the porch as the breakers roll in, with the setting sun tinting the restless waters."

He discovered and acquired five miles of undeveloped ocean frontage, sold beachfront lots for $500 each, with a down payment of 20 percent in cash, and got the town started. In order to create the Spanish atmosphere he wanted, building restrictions required that homes and business buildings have red tile roofs and white stucco walls. Lavish plantings of geraniums, bougainvillea and other colorful flowers completed the picture. Streets, parks and other public improvements were given Spanish names, reminiscent of early California.

San Clemente has no smog, and due to its location with respect to the surrounding terrain, and the prevailing ocean breeze, there is a minimum of fog and haze. Because of the tempering effect of the ocean, the summers are cool and pleasant, with an average yearly maximum temperature of 77 degrees, and the winters are moderate, with an average minimum of 57 degrees. Records show there is sunshine 342 days a year.

The town was incorporated in 1928, when the population was only a few hundred. There was no industry, and business was chiefly devoted to serving the residents, many of them retired persons.

U.S. 101 Is Main Street

U.S. Highway 101, principal north-south coastal route of the state highway system, formed the town's main street, El Camino Real. In time service stations, cafes and other businesses were established to meet the needs of highway travelers, who came in larger numbers each year as Southern California continued to develop.

In 1940 San Clemente had a population of 479, by 1950 this had increased to 2,009, and in 1960, the year the freeway came, the total was 8,527. A special census taken January 15, 1962, showed a population of 9,550, an increase of 325 percent since 1950. This gain reflected the growth of Orange County as a whole, which was 225 percent for the same period. The San Clemente Chamber of Commerce estimated 11,000 in mid-1963, and has projected 14,500 for 1965, and 20,000 by 1970.

For several years, while the freeway was being discussed, planned and built, there was speculation as to its effects on the community. What would happen to the tourist business when drivers could zip through town at 60 miles an hour? Would the town lose its quiet, semirural character? And would the freeway deface the cherished beauty of the hills?

As recalled by Postmaster John Phillips, who was president of the Chamber of Commerce in the late 1950's, most people wanted the freeway, even at the time its effects were uncertain. Traffic on the main street often was congested, especially on weekends, and the town "had become a bottleneck," Phillips said. People were anxious to get through traffic off the street, but there was a difference of opinion as to the freeway location. Opinions were divided between those in favor of the location close to the business district, as opposed to a route farther up the hillside.

"I was opposed to the location that was selected," said Phillips, "but I think most people now like the present arrangement."



A map of the San Clemente area showing location of the freeway



Hillside properties above the older section of the city are being developed in San Clemente since the San Diego Freeway was completed through the area.



In Capistrano Beach, north of San Clemente, this interchange links the San Diego Freeway (left to right) with the Pacific Coast Highway at Serra Junction.

Traffic Relief

After the freeway opened, through traffic no longer clogged the main street, and residents found shopping easier and safer. But some businesses that depended entirely on highway trade suddenly found themselves becalmed. Estimates vary as to the number that closed. Some say only three or four, others recall perhaps a dozen, including a cafe and some small service stations.

Councilman George F. Eyre, formerly the mayor, takes this view: "The freeway does a service to the city. As to adverse effects, it separated the men from the boys. It put people out of business who never should have been there in the first place, and put people in business who should be in business."

Asked further about detrimental effects of the freeway, he answered: "Who says it was detrimental? Maybe what we experienced was the depression. There is no doubt about the benefits of the freeway to San Clemente."

Benefits Cited

A year ago, when the city was nearing the end of the transition period that followed the opening of the freeway, City Manager Daniel L. Evans declared he was "sold on the freeway." He referred to the city's annual report which listed such accomplishments as city services provided for an average tax cost of $64.75; reduction of city debt; improvements at the city's Beach Club and at the municipal golf course; new streets; a safety record of no lives lost on the beaches; fire prevention program; new water lines installed, and a continuing beautification program.

Boyce Middleton, who has since retired as secretary-manager of the San Clemente Chamber of Commerce, recalled that even before the freeway was completed people living inland began to buy property for homes so they could live in San Clemente and drive to work in other communities. This trend has mushroomed into the current building boom. Building permits rose from $3,716,000 in 1960 to $4,567,000 in 1961. Then, with good transportation assured, the 1962 total jumped to $13,920,000. For the first five months of 1963 the permits issued



As the traveler approaches San Clemente from the north via the San Diego Freeway, signs remind him to watch for offramps in case he wishes to stop for gasoline, a meal or a bit of sightseeing in the picturesque seaside community



San Clemente's new civic center, housing police, fire and other departments of city government, overlooks the San Diego Freeway, business district and ocean from its hillside location. At left is recently completed church. Many new homes are being built in this area.



As the San Diego Freeway passes through the City of San Clemente it takes through traffic off the streets, yet is close enough to the business district to provide excellent local transportation service.



San Clemente's 18-hole municipal golf course not only provides recreation for residents and visitors from nearby Camp Pendleton, but puts some $30,000 a year into the city treasury. A salesman calls on industrial firms in all parts of Southern California to line up tournaments. The San Diego Freeway brings the players from distances that would have been discouraging in the prefreeway days.

amounted to $7,836,000. At midyear the chamber of commerce estimated that 1,400 homes were under construction or ready to start.

City 5 Miles Long

San Clemente, as it developed along both sides of the old Pacific Coast Highway, is five miles long. It starts four miles south of the junction of U.S. Highways 101 and 101-Alternate at Capistrano Beach, and its southerly limit is the Orange-San Diego county line. The San Diego Freeway as it passes through the city is only one or two blocks from the main street and slightly above it on the hillside. It is so landscaped that its traffic is hardly seen or heard from the street, and the shrubbery beautifies the hills where new homes are being built.

The most northerly on and off ramps are at Avenida Pico, leading to an area which is planned for light industry. Proceeding south, the next ramps are at Avenida Palizada, center of the business district. Other access points are at El Marino, Avenida Cordoba, at the point where the freeway crosses over El Camino Real (the main street), and at the southern city limit. Underpasses and overcrossings at a number of the principal streets enable traffic to move freely between the beach side of the city and the hillside areas. An underpass and short drive up the hill give direct access to the civic center where the police, fire and other city departments are located.



Since the San Diego Freeway came to San Clemente in November, 1960, through traffic, especially heavy on weekends and holidays, no longer clogs the main street, and residents are able to drive freely in the business district.



Well-located overcrossings and ramps facilitate the movement of traffic between the older part of San Clemente, lying between the freeway and the beach, and recently developed areas on the inland side of the city.

Most of the new commercial development has been on Avenida del Mar, which leads from El Camino Real to the hearth of the beach area and the municipal pier. The chamber of commerce, which formerly occupied quarters with the city offices in a converted garage, now has its own building on El Camino Real.

Community Values

Community values accruing to San Clemente from the San Diego Freeway, as expressed by civic leaders and by anonymous residents queried at random, may be summarized as follows:

Traffic congestion on El Camino Real and other city streets has been relieved. Through traffic, now on the freeway, no longer has to move through five miles of streets. Residents drive easily from their homes to shopping districts and the beach.

The rate of population growth has been accelerated.

Large areas are being developed for residential purposes.

. . . Continued on page 70

Negative Scribing

New Instruments and Film Increase Accuracy, Neatness

By JOE GAGE, Senior Delineator, District III

Negative scribing is a method of preparing copy for the reproduction of maps and plans in lieu of producing tracings by conventional drafting methods. It is well established in many private firms and public agencies which have a continuing need for high quality copy with emphasis on utilization of the many and varied advantages of modern reproduction techniques.

In District III, Marysville, we have recently investigated the application of negative scribing to one phase of the overall reproduction demand, that is, to the copying of photogrammetric maps for advanced planning, design, and rights-of-way.

Standard Procedures

Standard photogrammetric procedures for making maps involve the use of a stereoscopic plotter to compile planimetric and topographic detail from aerial photographs onto a map sheet. The plotter operator does this by continuous observation, interpretation, measurement, and recording directly from the three-dimensional stereoscopic model formed by the overlapping photographs. The product of this operation is a photogrammetric map manuscript—an original drawing in pencil.

The material on which this manuscript is rendered is made of polyester film of the mylar type. Although very tough and stable, it is quite abrasive and does not lend itself to good pencil take without a certain amount of rework. Also, neatness varies between individual operators. In short, the manuscript does not always meet the requirements for good reproduction.

Several methods have been tried for the preparation of good, readable copy without altering the inherent accuracy of the manuscript. But, without a doubt, scribing produces quality copy superior to that of any other drafting technique.



Scribing with a swivel cutting tool.



Scribing with a sapphire-tip cutting tool.

The scribing principle is very much the same as drafting. The only difference is that opaque material is removed instead of applied as with pencil.

Coating Is Transparent

Scribing film is also a mylar-type polyester film, but with a semiopaque emulsion on its surface. This coating is sufficiently transparent to allow tracing on a light table from copies under it, but yet filters out the intense arc light, except for scribed lines, when used as a copy negative.

The opaque emulsion is removed with special scribing instruments which have precut points ranging from 0.00025-inch to 0.03-inch line width. These produce a negative from which sharp, clear contact film reproductions can be made showing the most intricate details.

The instruments are numerous in types and styles. The points are much the same as phonograph needles made of carboloy steel or with sapphire tips, resulting in extreme accuracy and consistency of line weights. This is especially useful when fine lines are needed to show congested contours in mountainous areas.

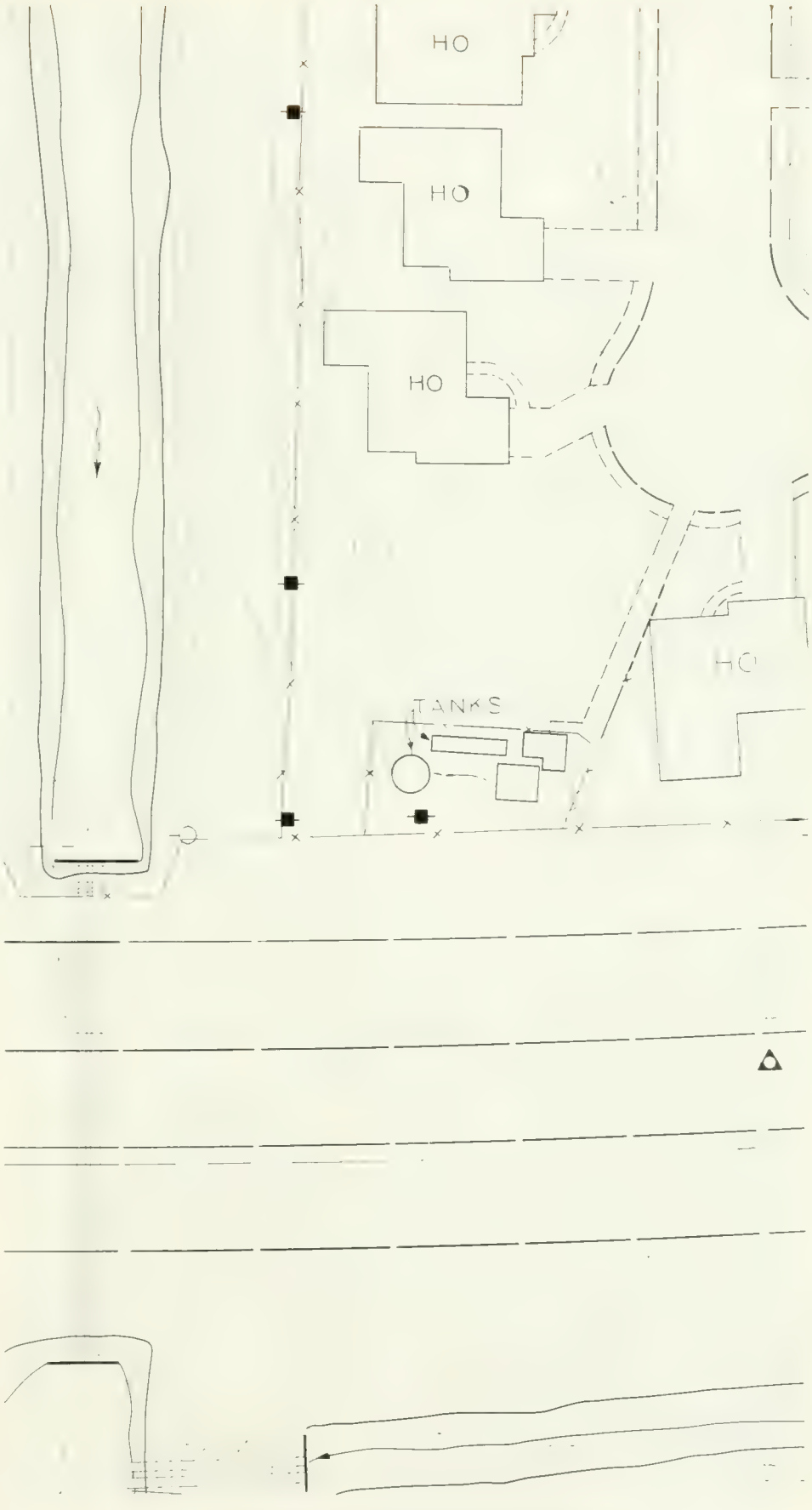
The steel needles have to be held vertically and can be used freehand. The sapphire tip can be used the same as the steel; however, it is not necessary to hold the needle vertically when used freehand to obtain a clean, sharp line. These can be used exactly as a pencil for lettering and line work.

Corrections or Changes

Corrections or changes are made by simply painting out an area with a special opaque compound and rescribing. Tedious dashed lines can be drawn as a single line, then dotted with the fluid to make a uniform broken line as desired.

A scribed drawing has no comparison in reproduction. There is not the density of ink or pencil to worry about and line weights made needle sharp are still reproducible.

Training the draftsman to scribe is far less extensive than training him to do neat ink or pencil work. The worries of ink splatters, line density, pencil weights, and smears and smudges do not have to be considered. The



A print from scribed copy. Scale is 1 inch to 50 feet.

draftsman simply selects the desired line weight from the precision-ground needles and begins to draw. Lettering can be done either by using lettering guides or freehand.

The first known record in the Division of Highways of a scribed mapping project dates back to January 1957, when Headquarters Photogrammetry Section mapped and scribed a sheet at a scale of 1″ = 400′ on Sign Route 21 in Alameda County. Several Division of Highways mapping projects have also been scribed by private mapping firms.

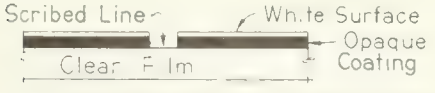
In co-operation with Headquarters Photogrammetry Section, we have investigated scribing at a scale of 1″ = 50′ on a small mapping project on U.S. 40 in Yolo County. The manuscript was compiled in pencil on scribe film and then delivered to the district for scribing.

Base Map

It was found desirable to have a base map showing only planimetrics and another showing both planimetrics and contours. To arrive at this, the planimetrics were scribed first, copies made, then the contours scribed.

From the film positive with only the planimetrics, contract plans can be made. This whole base map can be reproduced by the screen process and geometric details drawn with ink for contrast. Then layout sheets can be made by the double exposure process.

When scribing is done by the district, items not shown by the plotter, such as labels, existing culverts, and street names, can be placed on the manuscript by scribing or on the film positive in ink.



An enlarged diagrammatic cross section of scribed film.

In the scribing this district has completed, it has been found to be a considerable timesaver amounting to 10 percent for drafting of the base map, and 30 to 40 percent savings on an entire project through the right-of-way, design, and contract plans stages—enough, we feel, to warrant its use on all future projects.



Freehand instruments and needles. Top needle is sapphire tipped; middle needle, carboloy; bottom needle, plain steel.

Sixty Highway Jobs Are Awarded in June

The department of Public Works advertised for bids in June on 49 highway projects with an estimated cost of $23,257,100. There were 60 contracts for $34,872,600 awarded during the month and 32 contracts for $30,298,200 completed.

Bids from 191 contractors were opened for 47 projects, an average of 4.1 bidders per project.

The totals for fiscal year 1962-63 were as follows: projects advertised—545, for $353,163,700; contracts awarded—501, for $286,514,400; contracts completed—564 for $387,642,800.

Bids were received from 2,772 contractors on 523 projects, an average of 5.3 bidders per project.

1,083 PLANS CHECKED

The schoolhouse section of the Division of Architecture checked and approved the plans and specifications and supervised the construction on 1,083 primary, secondary and junior college projects during the fiscal year which ended June 30. The projects ranged from $10,000 alteration jobs to the construction of multimillion-dollar junior college plants.

Fill Settlement

New Foundation Techniques Used At Lagoons North of San Diego

By R. F. KOCHER, H. C. CHISHOLM and G. A. SMITH, Resident Engineers



San Diego, with a population of 617,000 is now the third largest city in California. There is an additional 550,000 population in adjacent communities. This rapidly expanding metropolitan area is located in the extreme southwest corner of the State. This unique location contributes to transportation problems since traffic is limited on the west by the Pacific Ocean, on the south by the international border and to the east by mountains, deserts and vast distances. The greatest volume of commodities and numbers of people are transported upon highways to the north.

The major arterial highway to the north is Interstate 5 (U.S. 101), a very important part of the interstate highway system. Interstate 5 within San Diego County is a part of the only interstate highway to traverse the entire length of the State.

U.S. 101 for the 35-mile distance between San Diego and the southerly terminus of the freeway through Oceanside and Carlsbad generally consists of a four-lane divided highway passing through the City of Del Mar and the communities of Solana Beach, Encinitas, Cardiff and Leucadia. Not long ago these were small beach communities; however, now they are important suburban residential areas of the greater San Diego complex.

Traffic congestion, particularly at the numerous intersections and at traffic signals in these communities, occurs with regularity. Numerous accidents, too many of which were fatal, have taken place on this section of highway and have resulted in considerable public reaction.

The accident rate on the existing highway has been increasing with the volume of traffic. The 1962 A.D.T. was 33,900 vehicles a day. Traffic vol-



The settlement fill at the San Elijo Lagoon showing the strut on the left side.



Another view of the fill at the San Elijo Lagoon showing the strut to the left.



ABOVE PHOTO. *Aerial of the San Elijo Lagoon showing the surcharge fill and struts looking north.* BELOW. *Another aerial of the San Elijo Lagoon fill taken higher up and looking south along the coastline.*



ume in 1954 was 25,500 vehicles a day. The 1954 rate was approximately twice that of 1946, the year that study, discussion and planning for improvement or relocation of this portion of U.S. 101 was started after World War II.

Relocation Is Best Answer

Engineering studies concluded that the best answer to the problem was relocation of this portion of 101. The planned relocation will be a six- and eight-lane full freeway, approximately three-fourths mile inland of the existing road. The old highway will be retained for local use in the coastal communities and recreational areas. Eventual completion of the relocation will remove the last traffic signal on the coast highway between downtown San Diego and Los Angeles. Construction will be divided into approximately 15 projects, over a period of five to six years.

Three projects, representing a cost of $4½ million, have been completed to date and work on another project, anticipated to cost $2 million, started recently. The primary objective of these completed projects was the construction of fills through poor foundation areas. The new alignment is intersected by several coastal valleys that are close to sea level elevation. The combination of ground water and fine-grained sedimentary soil makes these areas poor foundation for the roadway embankments.

Ten years ago, various sections of the freeway between Oceanside and Carlsbad were built through poor foundation areas "from the ground up." Foundation treatment of these unstable foundation areas consisted of dragline removal of unsuitable material to depths of four to six feet. The resulting trench was backfilled with suitable material. Embankment was then constructed in a normal manner, up to and including paving.

Improved Methods Developed

Since that time, improved methods have been developed for the treatment and handling of poor foundations. The treatment of the fill foundations on the just completed projects was completely different from that previously used in this area. Embankments on these projects have been

constructed directly upon the original ground without any prior treatment. The weight of the embankment is used to force excess moisture out of the foundation soils, with a resultant consolidation and increase in strength of the "in place" material. A large portion of the consolidation occurs during construction operations; however, it is necessary to delay final paving operations until this consolidation is essentially complete.

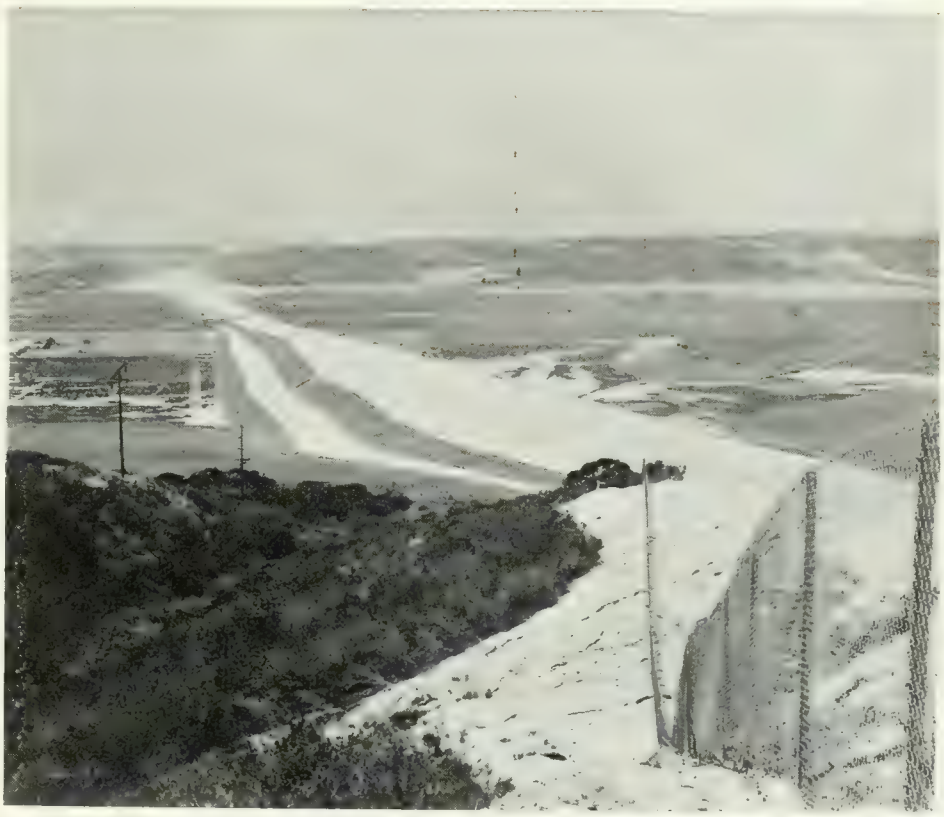
The "waiting period" between fill completion and paving may be up to three years, during which time several additional feet of consolidation may occur. Consolidation of the foundation soils is paralleled by settlement of the fill. Total settlement on some of the work completed is anticipated to be as much as seven feet. Acceleration of the settlement rate is obtained by placing a "surcharge" or additional height of fill above the planned grade elevation. This surcharge is removed prior to final paving operations.

Some Hazards

There are some hazards to the "ground up" approach, necessitating the application of carefully controlled construction procedures.

The construction of a high fill upon a structurally weak foundation soil increases the possibility of a foundation failure during the construction period. A saturated clayey foundation soil may be squeezed out laterally by the weight of the fill. This displacement would cause the fill, or portions thereof, to go down and possibly sideways. The original ground beyond the toe of the fill would rise or "heave." A "mud wave" may be formed under such conditions. Since this lateral movement or flow is a form of plastic flow, a major shear failure can result if the deformation occurs in large size.

The results of such shear failure may be disastrous. Complete loss or at least differential settlement of the fill, cracks and voids in the fill, and heave damage to adjacent property may occur. In some cases, complete removal and/or reconstruction of the fill could become necessary. To reduce the possibility of failure, the specifications of the completed con-



The 4,000,000-cubic-yard settlement fill across the San Dieguito River Channel showing the left strut.



Second contract, after completion, looking north. Fourth Street is in the foreground, the future Via de la Valle interchange in the background. The fill across San Dieguito Valley, upper portion of the picture, is to be completed under the current contract.

tracts provided for several protective features.

One provision was that fill placement could not exceed a certain rate. This rate varied according to the conditions encountered. On two of the projects, where very poor foundation soils were found, the rate was two feet in height during any seven calendar days. On the third project where somewhat better foundation soils were encountered, the rate permitted was three feet per seven days.

A structural feature, used to guard against foundation failure, was the construction of a low fill adjoining and contiguous with the main fill. This low fill is known as a "counterpoise" but commonly referred to as a "strut." The ballast or counterweight action of this strut resists lateral movement of the foundation soils.

The application of "rate" and "strut" features does not preclude all possibility of failure and there are economic limitations to their use. An excessively slow but safe "rate" would delay work completion. Overwide or oversize "struts" represent a waste of fill material and the purchase of additional right-of-way, both of which increase cost.

Continual Check

During construction operations, it is one of the many responsibilities of the resident engineer to continually check for signs of instability in the fill foundation. Should this checking indicate the established "rate" and "strut" provisions are not adequate to assure stability, additional measures must be taken immediately.

One such measure could be temporary discontinuation of filling, with work permitted to resume when consolidation of foundation soil had advanced to the point where it would support the weight of additional fill.

Another method would be the widening of struts.

Checking for signs of instability in fill foundations is done in several ways. Lateral movement in the foundation may be detected by "heave stakes." These stakes, of known original location and elevation, are set in the original ground at the toe of the fill. Periodic checks of the stake elevation and location are made. Any displacement of the stake from its original position indicates relative movement of the foundation.

A rapid and inexpensive method of checking displacement is the use of the "inclinometer." This device, recently developed by Arthur Root of Headquarters Materials and Research Laboratory, consists of a flexible plastic tube driven vertically into the original ground at the toe of the fill. Any subsurface movement of the soil will put a relative amount of curvature in the tube. The presence and magnitude of curvature may be established by "sounding" with metal rods of various lengths lowered into the tube. The curvature of the tube is indicated by the longest length rod that may be lowered to the bottom of the tube.

Valuable Instrument

One of the most valuable instruments, used to detect conditions that could contribute to foundation failure, is the piezometer. This apparatus is used to measure the hydrostatic pressure beneath an embankment. Should the rate of placing the fill be relatively greater than the escape capabilities of water in the foundation soils beneath the fill, an increase in hydrostatic pressure will result. If this pressure becomes excessive, failure may occur. There is little hazard where the foundation soil is coarse grained, because the water can be forced out rapidly. Major hazards are with fine-grained soils, where the smaller soil pores do not permit rapid escape of the water.

Actual construction began on the first of the projects through poor foundation areas of U.S. 101 in August 1961. This $2,400,000 project, awarded to Peter Kiewit Sons Co., consisted primarily of the construction of two bridges, 3,400,000 cubic yards of roadway excavation and 61,000,000 station yards of overhaul. The project was 3.24 miles in length and was located just east of the communities of Solana Beach, Cardiff and Encinitas.

The contractor's "dirt spread" consisted of six LeTourneau-Westinghouse B Tournapulls, with tandem scrapers. Two D-9 caterpillar tractors were used to push load. D-8 tractors were used to rip the cuts prior to loading. Fill material was spread with a Bege land leveler and compacted by a Wagner self-propelled compactor and by routing hauling equipment across the fill. This "dirt spread" averaged 14,000 cubic yards of roadway excavation per 7½-hour work shift. The average payload of the tandem scrapers was approximately 45 cubic yards. The contractor had to con-



The north bridge cone embankment at Batiquitos Lagoon.

struct a working platform across soft and yielding original ground prior to hauling through these areas. This platform was built by dumping and then dozing the materials into place.

In addition to a two-foot "rate" requirement, this project provided that certain fills would be built to elevations of 50 and 25 feet, respectively, above original ground, at which time no further work was permitted for a period of 60 days in one case and 180 days in the other. At the end of these delays, fill construction was permitted to resume. This special treatment applied to areas where the surface elevation of the original ground was up to five feet below water level of two lagoons and where very poor foundations existed.

Settlement Rate Checked

The rate of fill settlement was periodically checked during the work. At San Elijo Lagoon, this settlement was very uniform and appeared to be directly related to rate of loading. No "mudroll" or "heaving" was apparent and it appeared that moisture in the foundation soil was readily exuded.

At Batiquitos Lagoon, the settlement of the fill was very rapid but appeared nonuniform. Differential settlement occurred at the south end of the lagoon and random cracking of the fill occurred during the 180-day "delay" period. At the end of the waiting period, fill operations continued as planned. The cracks were covered by normal filling operations. There is no evidence that the newer upper portion of the embankment is affected by the cracks.

Bridge work represented $636,000, or approximately one-fourth the cost of this project. Skyline Drive Undercrossing, consisting of two box girder structures, each four lanes wide with shoulders, is 130 feet in length. San Elijo Undercrossing, also consisting of two box girder structures, each four lanes with shoulders, is 341 feet in length.

A new type of equipment used on construction of these bridges was the Beltcrete conveyor system. This replaced the use of a crane for depositing bridge deck concrete. This equipment, consisting of special lightweight



The fill across Batiquitos Lagoon under construction, looking north from Encinitas. The City of Carlsbad is in the far background.

conveyor belts rated at 140 cubic yards per hour capacity by the manufacturer, was capable of supplying a volume of concrete much greater than the amount a normal deck finishing crew could handle.

The contractor was represented on the project by Angelo Weir, superintendent; Clarence Hauschild, project engineer and Walt Brieholz, bridge superintendent. George A. Smith was resident engineer for the Division of Highways, and Zain Simonson was the bridge engineer.

The second project to be completed on the relocation of U.S. 101 is located just east of the City of Del Mar. This $1,700,000 project consisted primarily of 4,100,000 cubic yards of roadway excavation, 90,000,000 station yards of overhaul and the construction of two asphalt surfaced crossroads.

The contractor for this work was Peter Kiewit Sons Co., who utilized the same equipment used on the previously discussed project. Both projects were built concurrently and many of the conditions encountered were similar.

Roadway excavation was removed from two large cuts on this 2.54-mile project. One cut contained 3,000,000 cubic yards within 40 stations, or an average of 75,000 cubic yards per station.

The entire 4,100,000 cubic yards excavated on the project was placed in a single fill across the San Dieguito River basin. This fill is only 70 stations in length with an average volume of more than 47,000 cubic yards per station.

Fill foundations across this basin consisted of saturated clayey or silty sands. A working platform had to be constructed across a large portion of the basin prior to hauling. This platform consisted of a 3-foot to 5-foot thick layer of selected material, dozed into place. Settlement recording devices were installed and checked

Seattle Public Library
SEP 9 1963



The settlement fill across Batiquitos Lagoon, strut in the right foreground.

weekly. Settlement was fairly rapid and uniform, and appeared directly related to rate of loading. Piezometers indicated no excessive hydrostatic pressures. Inclinometers indicated no appreciable displacement or "heaving" at the toe of the embankment. All devices and observation, in fact, indicated that the fill rate of 3 feet per seven days, and the designated "struts" were adequate safeguards.

A portion of the project was "surcharged" to accelerate settlement and a portion was not constructed to final grade because it was anticipated that the ultimate fill height of 90 feet at this location would place such a large weight upon the foundation that failure could result. Construction of this fill will resume, on a separate contract, after a one-year "waiting period" during which consolidation and resultant strengthening of the foundation will continue.



The embankment at the south side of Batiquitos Lagoon. Note the "heave stakes" at the top of the embankment.

The contractor's force on this project was basically the same as on the first contract. Roger Kocher was the Division of Highways resident engineer.

Third Project

The third U.S. 101 project was awarded to the contractor, Earl Brown and Earl Brown, Inc. This project, constructed at a cost of $583,000, is 1.83 miles in length and is located southeasterly of Del Mar. The work consisted of 640,000 cubic yards roadway excavation, construction of frontage roads and major drainage facilities.

The contractor used Caterpillar DW-21 and 631 motor scrapers, push loaded by Caterpillar 660 and 630 tractors. Compaction was accomplished by routing the hauling vehicles and by a 10,000-gallon water wagon. The "dirt spread" on this project handled 8,000 to 10,000 cubic yards of roadway excavation daily.

Similar conditions to those encountered on the two previously discussed projects were found.

This project constructed fills over the Sorrento Valley slough, thus basically completing those portions of U.S. 101 relocation that crossed areas of poor foundations. Resident Engineer for the Division of Highways on this project was Henry C. Chisholm.

The fourth contract, which is just commencing, will encompass the limits of the second and third contracts recently completed. Approximately half of this $1,800,000 project will be bridge work. The plans provide for structures at Via de la Valle, San Dieguito River, Fourth Street and Carmel Valley Road, plus a multiple box culvert just south of Carmel Valley Road. Construction is by R. E. Hazard Contracting Co. and W. F. Maxwell Co. and includes grading and paving frontage roads plus completing the surcharged fill across the San Dieguito River Valley.

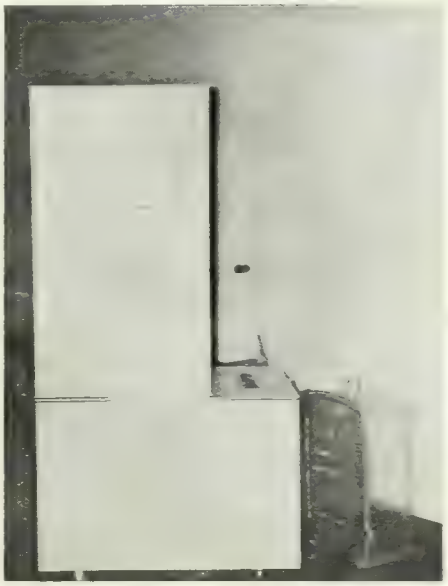
The first paving contracts on the relocation are set for advertising in late 1963.

The early construction of the fills across the potentially unstable lagoon areas should result in a facility constructed on well-stabilized embankment, at a minimum cost.



Designed to display colored transparencies of highway, anticipating scenic roads, planning steps, etc., nine windows of box to left are activated either in sequence or all at once by electronic programming. (This is photo of exhibit in use in department store display window. Maintenance procedure has simply been daily visit to make sure no lights burned out.)

District IV Develops Effective New Technique For Illustrating Highways



Side view of device at right in top photo. Inside lower unit, under grill, is slide projector holding 80 slides which are projected in screen (see photo above, upper right) by series of mirrors. Slides also are changed electronically, and suitable titles can be interspersed between pictures.



Ingenuity in District IV has produced two excellent audio-visual aids for displaying color transparencies either as a small independent exhibit, or in combination with other elements in a large exhibit. Both are planned to use the psychology of a changing series of photos to attract attention with movement.

Captions on these photographs explain how each of the units operates. The large transparency dislay has already been used effectively in a large San Francisco hotel, and in a display window of a large department store. Plans and instructions for building similar units can be made available by District IV to other interested districts.

National Highway Week

In California the third annual National Highway Week, May 26—June 1, 1963, was far more extensively observed than either of its predecessors.

Unfortunately, despite Governor Edmund G. Brown's exhortation in his National Highway Week statement to "make our driving worthy of our highways," the observance was marred by an unusually high total of fatal accidents during the Memorial Day weekend.

The long-range results of National Highway Week, on the other hand, were clearly on the plus side. Through the media of the press, radio, television, speeches, graphic displays and informative "handouts," hundreds of thousands of Californians, perhaps more, were enabled to learn a great deal about the progress and problems of their state highway system.



The National Highway Week exhibit at Los Angeles International Airport.

Local, Statewide Progress

The State's press, as it has in the past, gave widespread "play" to National Highway Week, with emphasis not only on local and regional highway progress but also with extensive mention of the statewide picture. A 17-page news release citing the highlights of recent, current and budgeted freeway construction and other improvements, as listed by State Highway Engineer J. C. Womack, was widely used. This release showed that as of the end of May 1963 California had:

—Increased its mileage of full freeways by 214 miles in the past year, of which 54 miles were converted from expressway standards by replacing crossings at grade with separation structures. The State now has 2,584 miles of multilane divided highway in operation, of which 1,187 miles are



Undersecretary of Commerce Clarence D. Martin is shown speaking at the dedication of a portion of the San Diego Freeway in southwestern Los Angeles during National Highway Week. The signs in evidence in the crowd refer to an interchange on an adjoining project.

full freeway. Another 400 miles of freeway and expressway are under construction.

—Completed, placed under construction, or under engineering design a total of 2,048 miles of its 2,177-mile segment of the national interstate highway system.

—Expended or obligated, according to latest figures of the U.S. Bureau of Public Roads, a total of $1,422,800,000 on interstate system projects, far more than any other state.

—Adopted routings for 6,537 miles of access-controlled highways, or 53 percent of the 12,400-mile freeway-expressway system established by the Legislature in 1959.

In most areas of the State the various district offices of the Division of Highways supplemented the statewide report with detailed reports of highway developments on a county-by-county basis. Maps showing regional freeway progress were published by several of the larger metropolitan dailies.

Editorials Take Note

Several newspapers took editorial note of the observance.

"Progress is born in the wake of prosperity," said the San Bernardino *Sun*. "And prosperity travels modern highways and freeways that provide convenient and swift transportation.

"California's superior highways and freeways did not come by chance. Men of vision—desiring that the Golden State become the most productive and prosperous member of the union—planned our great system of highways and freeways. Their foresight has paid rich dividends. Not only is California the most populous state, but it also possesses the potential to become a veritable empire of prosperity in the immediate years ahead."

The San Luis Obispo *Telegram-Tribune*, after citing examples of statewide and area highway improvement, concluded its editorial:

"California's major highway system is something to be proud of, and we heartily agree with the division's spokesman that the past year has been one of remarkable progress."

In the northern part of the State, the Red Bluff *Daily News* commented on its major local project as follows:



Carlos Apablasa (left), design engineer in the Division of Highways District VII office, is interviewed by news commentator Alejandro Nervo on Spanish-speaking TV Channel 34 in Los Angeles during National Highway Week.

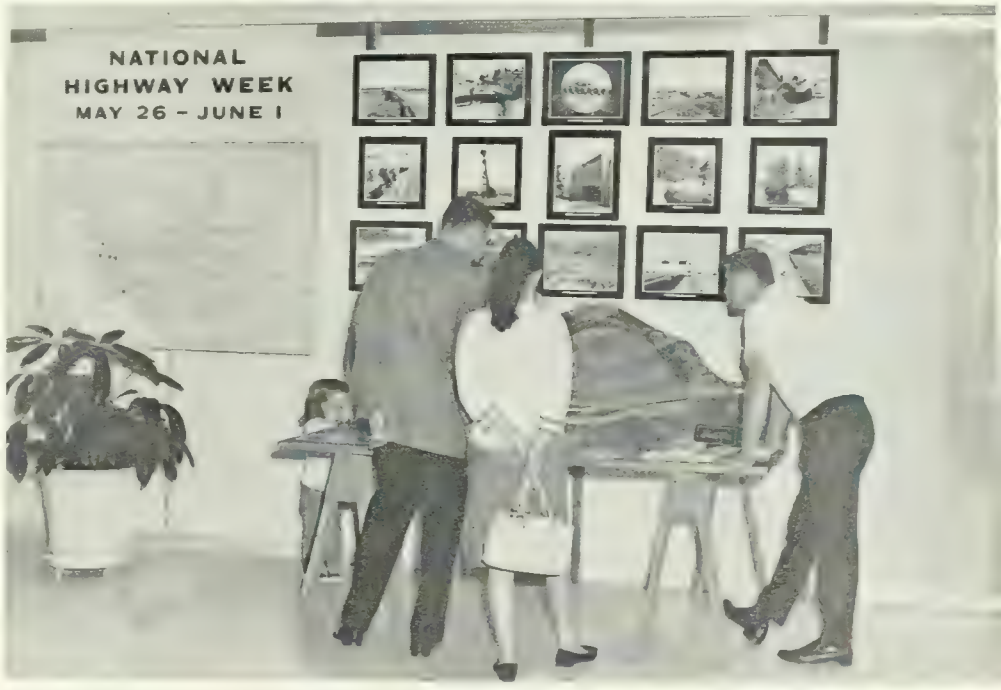


PHOTO ABOVE. K. G. Corbin, delineator with the Division of Highways District VIII office in San Bernardino (right), explains the "Crestline Interchange" model to passengers waiting in the Ontario International Airport lobby.

BELOW. Freeway system exhibit in the San Luis Obispo Public Library.





Display in the front window of a store in Bishop prepared by the District IX staff in observance of National Highway Week.

"This spring with work underway on the bridges that will be the most important part of the Red Bluff Freeway (Interstate 5), there are still some people that feel that it will have a depressing effect on our city's economy.

"But if they will take time to analyze what has happened in other communities they will realize the meaning of Mr. Womack's remark: 'The benefits of properly planned freeways to small and medium-sized cities are becoming more and more obvious. Local traffic makes better use of both the freeway and the local streets, local business is enhanced, and community planning can go ahead on a sound basis.'"

The first six pages of the 16-page "weekend" section of the May 25 San Mateo *Times* were devoted to an article by Vera Graham spelling out in words and pictures the current and projected freeway progress in San Mateo County and saluting the engineering staff of District IV.

Special Events

Although the most extensive observance of the week took place in District VII, where a special Southern California National Highway Week Committee was headed by former Highway Commissioner Robert E. McClure, Santa Monica editor-publisher, there were special events in many parts of the State where the first two versions of the week had received relatively little attention.

In addition to the hundreds of news articles, there were numerous displays and exhibits, talks to service clubs, and, in Redding, even a church sermon.

The exhibits generally featured photographs and maps of highway construction, plus some special activities such as route planning, aerial surveys and landscaping.

Favorite Locales

Public libraries, airports, and Division of Highways district offices were favorite locales for exhibits, as well as local store windows. Among the libraries co-operating were the Kern, Fresno and Inyo County Libraries, and the San Luis Obispo Public Library. There was an extensive exhibit at the Los Angeles International Airport and another at the Ontario International Airport. Downtown windows and commercial lobbies in Los Angeles, San Francisco, Bishop and Stockton carried exhibits.

The District VII observance was highlighted by the dedication ceremonies on May 28 for a key section of the San Diego Freeway (Interstate 405) in the Inglewood area, signalizing the completion of a 41-mile section of this freeway from San Fernando to Long Beach. U.S. Undersecretary of Commerce Clarence D. Martin was the featured guest at the freeway dedication and at the luncheon which followed.

Other Features

Other features of the Los Angeles observance, in addition to the airport display, were two unusual television shows. On one, Elmer Peterson, KNBC newscaster, showed color slides of landscaped freeways made available by Los Angeles Beautiful; and on another, a member of the District VII staff was interviewed in Spanish on Station KMEX.

Through co-operating gasoline dealers the Division of Highways made 150,000 freeway progress maps available to Southern California motorists, with a description on the back of the state and regional long-range freeway plans. The National Highway Week Committee, representing a variety of organizations, also issued news releases and other literature.

Lemoore Project

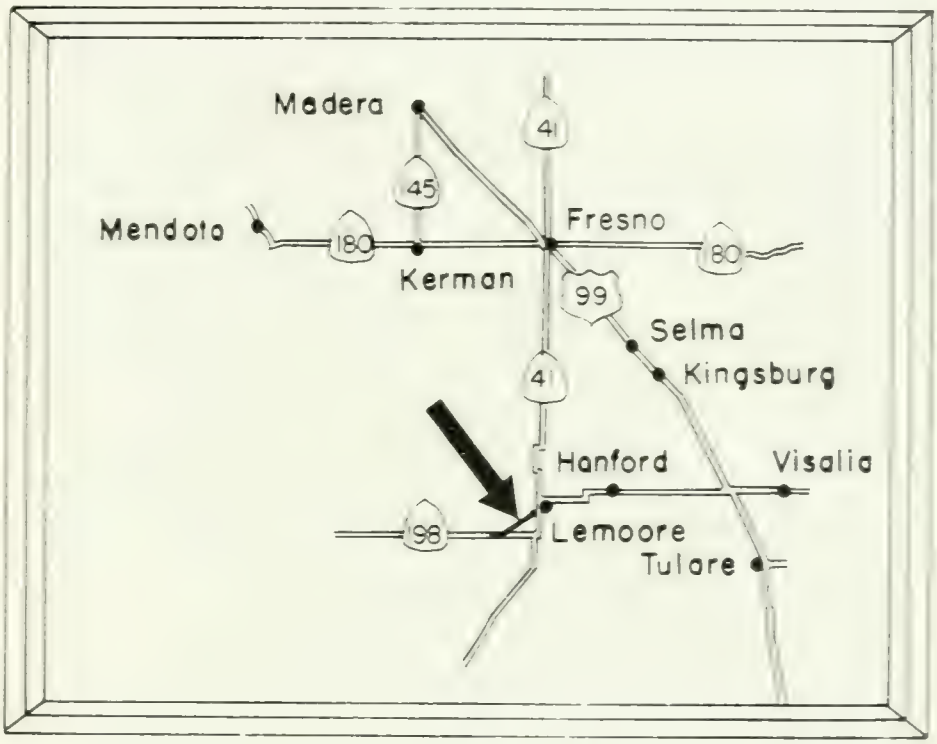
Activation of Naval Air Station Advances Freeway Schedule

By THOMAS S. ASHLEY, District Advance Planning Engineer, and
WILLIAM L. GILFILLAN, Resident Engineer

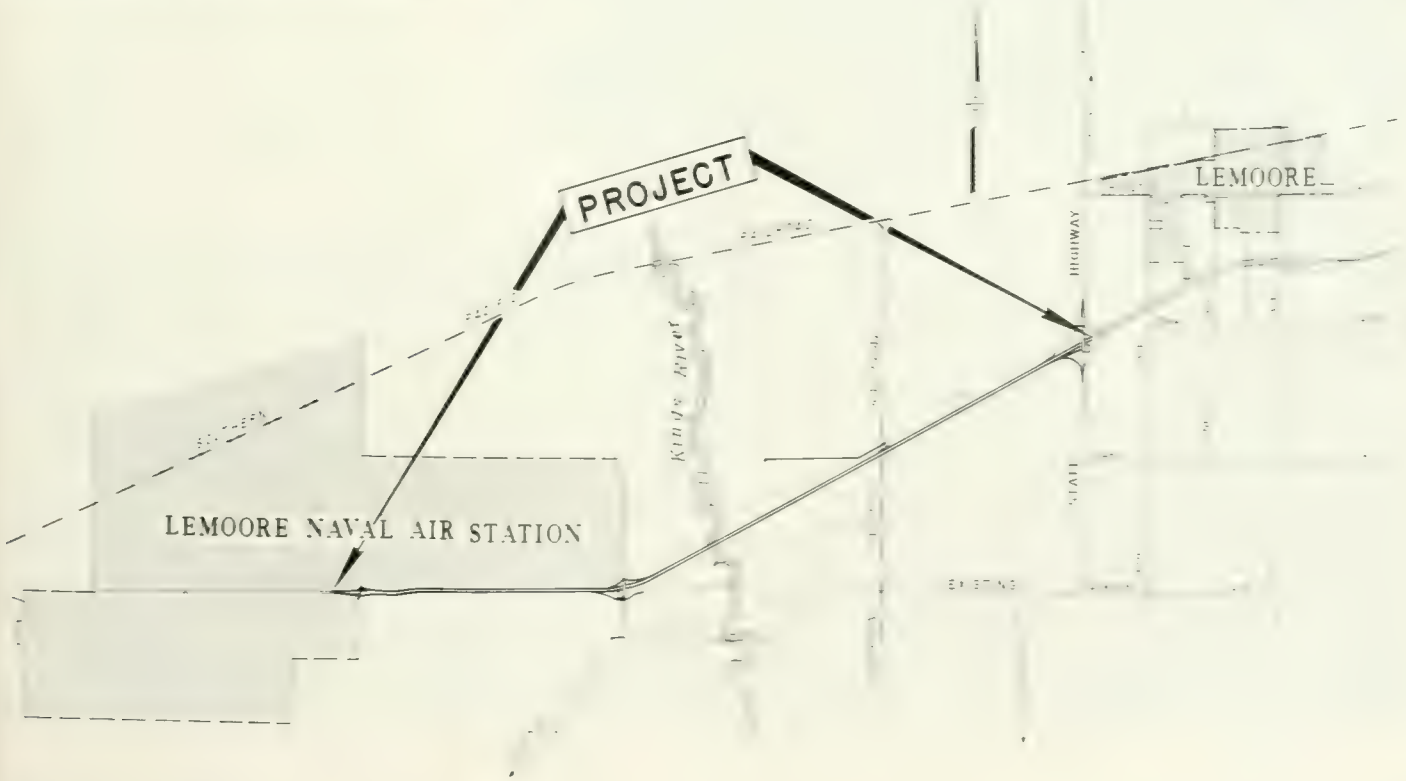


A flight of Navy jets zoomed overhead as Public Works Director John Erreca cut the proverbial ribbon officially dedicating the first freeway section to be built in Kings County. This is a section of Sign Route 198, 6.5 miles in length between the main gate of the Lemoore Naval Air Station and Sign Route 41 near the outskirts of the City of Lemoore about 40 miles south of Fresno.

Erreca praised the efforts of local citizens and representatives in state government from that area in pushing the project. The opening ceremonies.



These two maps show the general location of the project right in relation to neighboring cities and below its specific location between Lemoore and the Naval Air Station.





The twin bridges across the Kings River looking west.

held June 14, were sponsored by the Committee of Twelve, a Kings County citizens group which was instrumental in speeding up the programming of the project. Lemoore's mayor, Arthur DeRadd, was the master of ceremonies.

Planning Started in '53

Planning for the improvement of Sign Route 198 began back in 1953. At that time it was believed the improvement of only the section east of Sign Route 41 was essential. Later, when it became apparent the Navy would build an air station to the west, these limits were revised.

After origin and destination surveys were completed and informal conferences were held with local officials, a public hearing was conducted in June 1957. Because some issues were introduced at this hearing requiring additional study, another public presentation of new facts was made two months later. In November the board of supervisors asked for a delay in route selection until a North Kings County area general plan could be completed. The following year plan studies were ended and a third hearing was held in Hanford September 4th, this time before the California Highway Commission. A month later the commission adopted a route between the Fresno-Kings county line and one-half mile east of Sign Route 43, a section 21.6 miles in length.

Freeway agreements were executed with the City of Hanford and Kings County in the summer of 1959 and



Looking west at the Sign Route 41 overcrossing.

plan preparation began soon after. It was obvious that, with the rate of financing normally available to Kings County state highway construction, the project would have to be divided into construction units of reasonable contract size. Because of anticipated traffic demand to be generated upon completion of the air base, the portion between the main gate of the air station and Sign Route 41 was given top priority. Preparation of right-of-way appraisal maps was begun in October 1959 and the construction plans were completed in July 1961 for this construction unit.

As late as 1960 it had been determined that, due to other pressing projects in the district, a major construction project on the freeway for Sign Route 198 in Kings County could not be financed until the 1963-64 fiscal year. However, in 1961, considering the fact that activation of the air station was scheduled for July of that year, the California Highway Commission decided to advance the project and amended the 1961-62 state highway budget by awarding $3,000,000 for construction.

Contract Is Awarded

The construction contract was awarded in December 1961 to Miles-Sierra Contractors of Merced and work was begun the same month.

The project was primarily a truck-haul borrow job. Thirty thousand cubic yards of roadway excavation and more than 1,550,000 tons of imported borrow were required in the construction. Six major structures at four locations were required, including parallel bridges at the crossing of the Kings River.

A comparatively simple uniform structural section consisting of three inches of asphalt concrete over six inches of Class "A" plant-mixed cement treated base, all over a uniform layer of eight inches of aggregate subbase material was used throughout the entire freeway portion of the project. The plant-mixed cement treated base feature of this design was the only item unique to the district in that this was the first District VI project requiring a plant-mixed base. The contractor elected to use a 400-ton-per-hour pugmill-type continuous mix



Looking west along Sign Route 198. Part of Lemoore Naval Air Station is in the upper part of the photo. The Kings River is in the foreground.



A westerly view of Sign Route 198 at the Sign Route 41 interchange



Approach to the entrance of the Lemoore Naval Air Station.



A westward view of the Sign Route 198 freeway and the Naval Air Station residence area.

plant fed directly from bottom-dump trucks to small holding bins which gave him only 25-ton reserve of each size aggregate. Both the plant and quality of mix were, in general, trouble free and produced a very satisfactory, uniform product when placed on the roadbed.

Superintendents Listed

Project superintendent for the contractor was J. M. Martin of Bakersfield. The State's bridge representative was Matt Segal and the construction engineer was J. M. McDowell.

Total construction cost was about $3,000,000.

The next freeway project on Sign Route 198 is scheduled to begin sometime this fall. Plans call for the construction of a four-lane freeway and expressway 10.4 miles in length between Sign Route 41 and 11th Avenue in Hanford.

Other state highway projects in Kings County will follow soon. A two-lane expressway on Sign Route 41 between the Kings River and Elkhorn Avenue has been budgeted and work should begin by the end of the year. About 27 miles of four-lane Westside Freeway (Interstate 5) will course through the county by 1972.

Contract Awarded on Bridge Substructure

A $12,626,402 contract for the substructure work of the future high-level spans over the navigation channel for the San Mateo-Hayward Bridge was awarded to Pomeroy-Gerwick-Steers, San Francisco, on July 5.

The substructure contract is a major unit of a long-range $70,000,000 project to increase the bridge's capacity, presently two-lanes.

The concrete trestle portion of the bridge east of the navigation channel is being reconstructed to four lanes under a $13,250,000 contract, and will be widened to six lanes when traffic requires. The high level portion will be constructed initially to six lanes.

Aerial Inventory

Large-scale Aerial Photos Aid Traffic Engineering

By THOMAS N. TAMBURRI, Assistant Traffic Engineer

(*Editor's Note:* This paper was presented at the 1963 meeting of the Highway Research Board in Washington, D.C.)

Synopsis

In the fall of 1960 and the spring of 1961 the Los Angeles area district and the San Francisco area district of the California Division of Highways were supplied with a 1″ = 200′ scale aerial photographic inventory of most of the existing freeways in those areas. This initial inventory on 348 miles of freeways then existing in these two areas was of an experimental nature to determine whether large-scale aerial photography would be useful for traffic engineering applications such as studies of accident prone locations, determining vehicle paths, and studies of signing problems.

Introduction

The photographs in the Los Angeles area were taken between April 25 and May 12, 1960, and the material was accepted by the Division of Highways on August 18, 1960. The photographs in the San Francisco area were taken between December 22, 1960, and March 23, 1961, and accepted on May 18, 1961. In each case the materials obtained were two sets of 9-inch by 18-inch contact prints on double weight semimatte paper at a nominal scale of 1″ = 200′, two sets of photo index maps, and all negatives. A typical contact print is shown in Figure 1.

The work was done as two separate contracts. The contractors were supplied with 1: 24000 scale USGS quadrangle maps showing flight lines and locations to be photographed. The contracts required vertical aerial photography taken with a camera having a nominal focal length of 24 inches and a negative size of 9 inches by 18 inches. The 18-inch axis was oriented along the flight lines giving a coverage of 1,800 feet wide by 3,600 feet along the highway. Overlap of at least 15 percent was specified.

At interchange locations where ramp terminals were located more than 700 to 800 feet from the flight lines, additional coverage along the crossroads were obtained.

Total cost, excluding engineering by the Division of Highways, for the 348 miles flown was $7,130.40 or $20.49 per mile.

Photos Widely Used

The photographs have been enthusiastically accepted and are being used in a wide variety of ways. Some of these uses include traffic engineering studies, research studies, design, planning, maintenance, project review, programing of improvements, and communications.

Traffic engineers of the California Division of Highways use the photographs to study accident-prone locations, to determine vehicle paths in relation to various geometric features, and to study signing problems. The photographs have also been used to de-

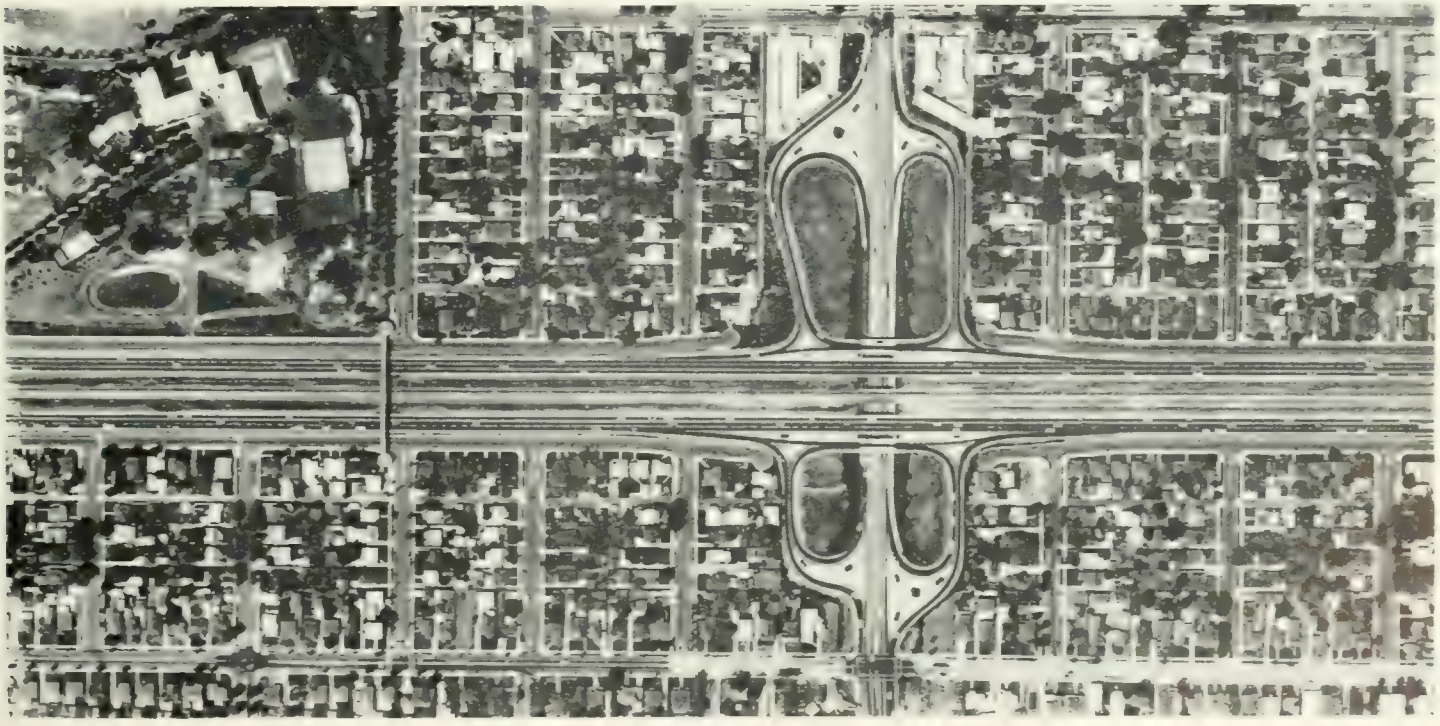


FIGURE 1. An aerial photo of a freeway location before identifying data has been superimposed.

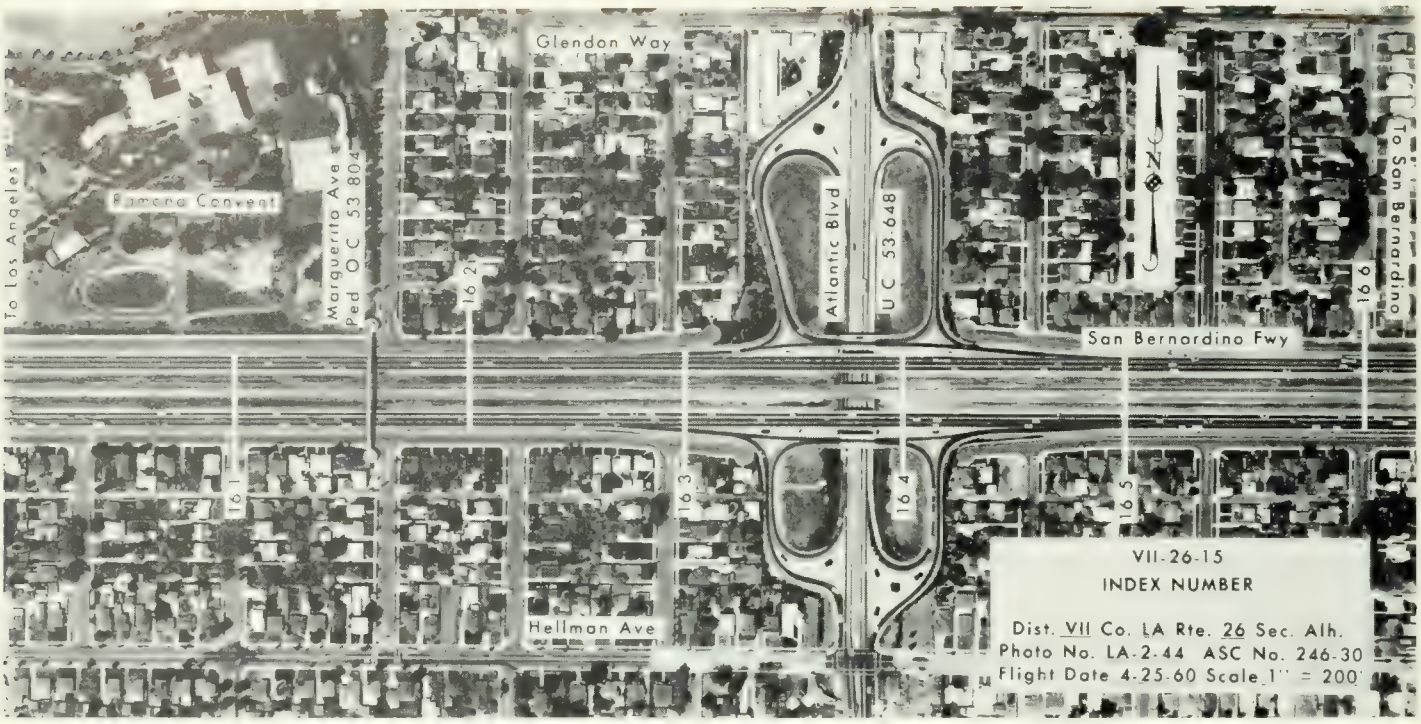


FIGURE 2. A print of the same photo (previous page) after mileposts and other data have been added for accident-locating purposes.

termine the location to place pavement markings at interchanges and at intersection of ramps with surface streets, thus reducing the amount of fieldwork normally required. Further, the photographs permit parking studies and studies regarding striping, signing, median barriers, illumination, and traffic control, with a minimum amount of fieldwork and review. In addition, the photographs either eliminate or reduce the research ordinarily required into old plans, cross sections, and records for the above-mentioned traffic studies and for planning locations for traffic-counting stations.

The 9-inch by 18-inch contact prints have been reproduced in a variety of forms and scales to be used as exhibits in various reports. The unretouched reproduction is used to show existing conditions. Proposed changes have been shown by delineating the recommended change in ink or colored pencil on the reproduced print.

Convenient and Accurate

The photographs are a convenient and accurate inventory of existing facilities and as such they have been found valuable in planning and programing needed improvements. The photographs are more effective than maps in helping private citizens and technical staffs of local agencies in identifying properties and in visualizing improvements. The public in general, and especially property owners and developers seeking information, are favorably impressed by the fact that these photographs are available and by the efficient manner that the engineer can communicate with the public with the aid of the photographs.

The San Francisco area district office has utilized the photographs to produce base maps in planning an im-

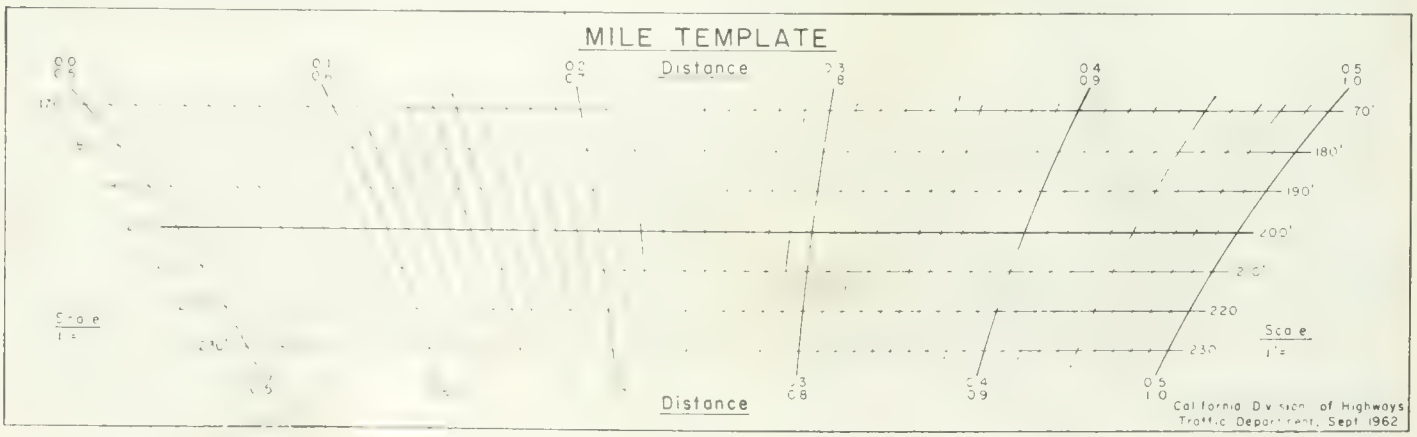


FIGURE 3. The transparent variable overlay scale.

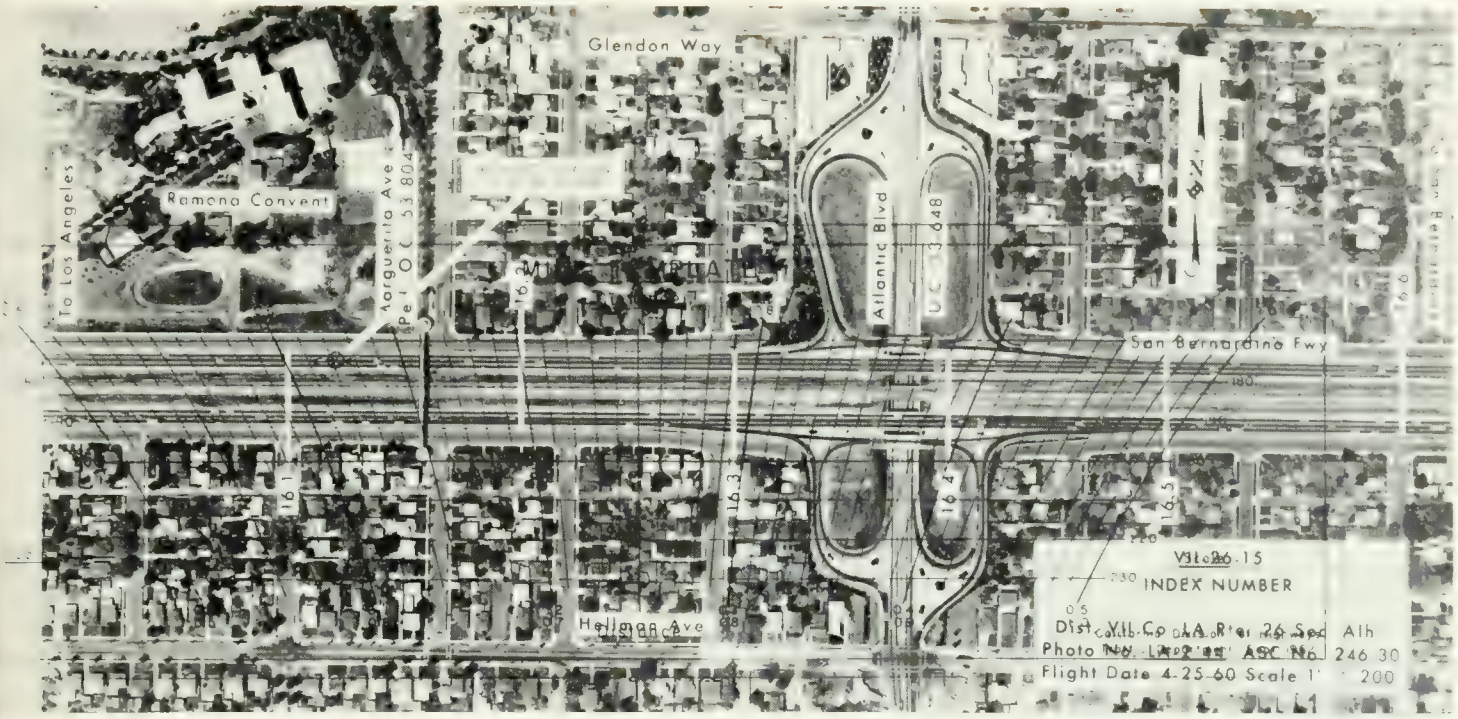


FIGURE 4. The same photo (previous page) with overlay scale superimposed to determine the location of an accident.

provement to an existing freeway. This freeway is located in the City of San Jose on relatively flat terrain. A great deal of development has taken place along the right of way since the freeway was initially constructed so the contract plans ("as builts") were of little value for making a base map to plan the revisions required.

Scale Maps Prepared

In cases such as this, it is customary to obtain photogrammetric mapping. This would have required several weeks. To expedite the preparation of the needed base maps and to reduce costs, the district prepared $1'' = 100'$ scale maps using the $1'' = 200'$ scale photographs. Known distances between easily identified features along the freeway, such as ramp noses, bridges, and culverts, were used to determine the exact amount each photograph should be enlarged to produce the $1'' = 100'$ scale photographic base maps on sensitized polyester film. The amount of enlargement varied from photograph to photograph since photographic scale is a function of flight height, ground relief and camera tilt. The resulting base maps, however, were reasonably close to the desired scale of 1 inch equals 100 feet along the freeway although scale in the transverse direction was not necessarily the same nor uniform.

Although the finished product was not as accurate as that which could have been obtained from photogrammetric mapping, it was sufficiently accurate and detailed for the purpose of planning the additional lanes required and for the preliminary design of modifications to the existing interchanges. Photographic mapping will be obtained for the detailed design of the widening project. The total time to produce the base maps from the photographs was 10 days.

Maintenance Use

The photographic inventory also has many useful applications in the maintenance field. The photographs are very helpful in analyzing drainage problems by locating existing facilities, spotting controls, and to determine corrective measures. They are used in discussing numerous other field problems between office and field personnel. The aerial photograph eliminates the need of specially prepared sketches to illustrate the discussion.

In relinquishing old highways to local authorities and in drawing up maintenance agreements with local agencies, the photographs have been helpful in verifying details shown on plans or maps and in extending coverage beyond the limits of existing plans and maps. The photographs help to point up logical limits by showing such controls as fences, roads, curbs, drainage way, landscaping limits, and other geographic, topographic, and physical features.

Another application by the Maintenance Department is in issuing permits for encroachments and for transit of extralegal loads. The photographs expedite investigations and decision making on such applications by showing the degree and type of occupancy in the vicinity of the requested permit, and by showing other relevant factors such as driveways, traffic control devices, bridges, signs, and other restrictive controls.

Other Uses

Researchers conducting studies on speed, capacity, and safety have found the photographs useful. In a research project regarding wrong way driving incidents on freeways, the aerial photographs have been very helpful in reconstructing the event and the path traversed by the vehicle to determine points of wrong-way entry. Diazo prints of the contact prints are also being used to outline and to codify data of various geometric elements of

each interchange in a study to relate accident rates to freeway design details.

Still another application being investigated is the use of photographs to pinpoint the location of individual accidents. Two locations totaling approximately 50 miles of U.S. 40 (Interstate Route 80) between San Francisco and Auburn are being used as a pilot study. Multilith prints of the photographs have been furnished to the California Highway Patrol. A copy is attached to each accident report by the officer after he indicates the location and the type of accident on the print.

The multilith prints are obtained by a screening process of the semimatte photograph original. The prints are relatively inexpensive. In quantities of 100 or more the cost is approximately three cents each. Before making the multilith masters, identifying prominent landmarks, cross streets, milepost points, north arrows, and directions to nearest towns are added to the photographs. (Figure 2.) The accident location can then be quickly obtained using a transparent variable overlay scale. (Figures 3 and 4.) An ordinary scale cannot be used since the photograph scale is not necessarily 1 inch equals 200 feet; varies from photograph to photograph; and varies within a photograph due to camera tilt, flight height, and relief. It is hoped that this special scale will simplify the task of determining the accident location. This is now done by computing the milepost using distances from physical objects measured and recorded in the report by the officer. Thus far, however, there has been insufficient experience with this application to determine its efficiency. Also, there is evidence that the patrolmen are having difficulty in locating the accidents accurately on the photographs.

There has been some demand to increase the scale, obtain wider coverage, and extend coverage to all major highways (conventional highways as well as freeways). Doubling the scale to 1 inch equals 100 feet would increase costs approximately 75 percent. The cost of eliminating scale distortions would be prohibitive. It is felt that neither the larger scale nor a more accurate scale is necessary for the general applications that these photographs are used.

Summary

Although the original experiment was designed to determine how useful large-scale aerial photography could be for traffic engineering studies, engineers in most other fields of highway engineering soon found applications in their own specialties. These applications include the fields of traffic engineering, research, planning, programming, design, maintenance, and public relations.

The experiment has been so successful and demand has been so great that coverage will be extended in the near future to all freeways in the State. It is planned to maintain this coverage on a current basis by annually photographing improved, modified, and new sections of freeways.

HIGHWAY THROUGH HISTORY

Continued from page 20 . . .

decision to build the proposed Auburn Dam on the North Fork of the American River.

From south of Grass Valley to three-fourths mile east of Nevada City, 7.2 miles through the two towns, a freeway route has been adopted and construction plans are nearing completion. The whole project is estimated to cost some $6,000,000, and the first unit, which will run 3.3 miles from near the east city limit of Grass Valley to east of Nevada City, will require about $4,000,000. Most of the right-of-way has been acquired, but construction money has not been budgeted.

Advance studies for the nine miles in Yuba County from the Yuba River to northeast of Camptonville, have not yet been started. This portion was built in the 1930's by the Bureau of Public Roads and still is one of the better portions of the highway.

Advance planning calls for correction of substandard alignment at various points west of Downieville; replacement of the bridge at Downieville; reconstruction and widening on a route adopted in 1960 between Bassetts and Yuba Pass; widening on a new but as yet unadopted alignment between Yuba Pass and the junction of Sign Route 89 and further reconstruction between Sierraville and Loyalton.

Matt Fredericksen Retires on July 1

Matthew Fredericksen, Assistant Office Engineer in charge of Project Control with the Division of Highways, retired July 1 after 35 years of state service.

Fredericksen's engineering career with the division began in 1928, working on surveys and construction in Northern California. This included the survey of the Feather River Highway location (U.S. 40 Alternate) in Plumas County, and the survey made for the Eagle Lake Road between Susanville and Bieber—an 80-mile survey completed in the record time of eight months.



MATT FREDERICKSEN

Following this he was resident engineer on some of Northern California's largest highway construction projects, among which was the highway relocation around Shasta Dam Reservoir from 1938 to 1942, involving approximately 16 miles and an expenditure of about $2 million. This relocation involved some of the heaviest grading connected with highway development at that time.

Since 1942 Fredericksen has held his present position in Division Headquarters in Sacramento, entailing contract administration and supervision, contract progress records, and various fiscal matters.

Fredericksen was born in Poulsbo, Washington, where he attended grade and high schools, going on to the University of Washington at Seattle. His training also included three years of law through LaSalle Extension University. During the 10 years prior to his employment by the Division of Highways, Fredericksen was engaged in survey and construction work on highways and railroads in Idaho and Oregon. He had also served in World War I.

He is affiliated with the Masons, and Alpha Tau Omega fraternity. Fredericksen is married and has a daughter.

Permeability Test

Compaction, Water Studies Made on Asphalt Pavements

By ERNEST ZUBE, Supervising Materials and Research Engineer

Introduction

In constructing a stable and durable asphalt concrete pavement, two important steps are necessary. First, the mixture must be correctly designed; and second, it must be properly compacted.

In the design of the mixture such factors as gradation of the aggregate, particle shape characteristics and surface texture, absorption of asphalt by the aggregate, and optimum asphalt content are important considerations. In the laydown operations, temperature of the mix, type of compaction equipment, and air temperature are of paramount importance.

If, in the finished pavement the void content is high, particularly when the voids are interconnected, the passage of air and the admittance of water will adversely affect the durability and ultimate life of the pavement mixture. The entrance of air into a permeable pavement contributes to the rapid hardening of the asphalt binder primarily through oxidation and evaporation. This article deals primarily with the compaction and its influence on water permeability of asphalt concrete pavements.

Evidence Is Collected

Over the years, the Materials and Research Department has collected a great deal of evidence which indicates that many asphalt pavement failures are attributable directly to the presence of excessive amounts of water which entered the pavement structure after construction. We have noted that pavement from failed areas often contains colloidal fines in the intimate part of the mix and particularly in the lower course of the asphalt pavement. This is caused by a pumping action resulting from deflection under heavy loads. The infiltration of fines from muddy water into small cracks of the pavement mixture will considerably reduce the cohesion of the mixture and also prevent any possibility of the cracks "healing" under traffic action during summer temperatures.

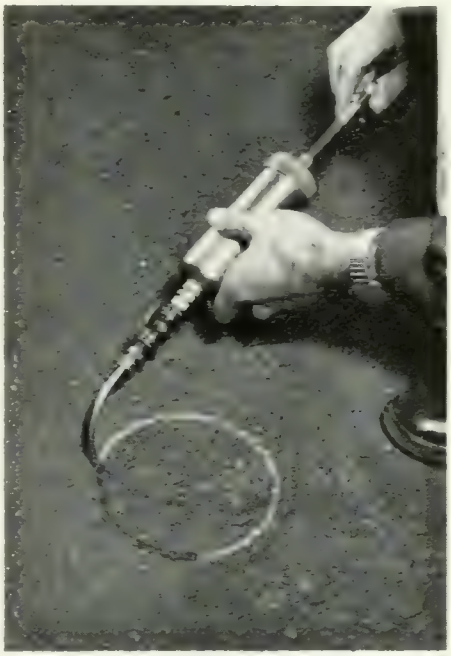


FIGURE 1A. Forming grease ring.

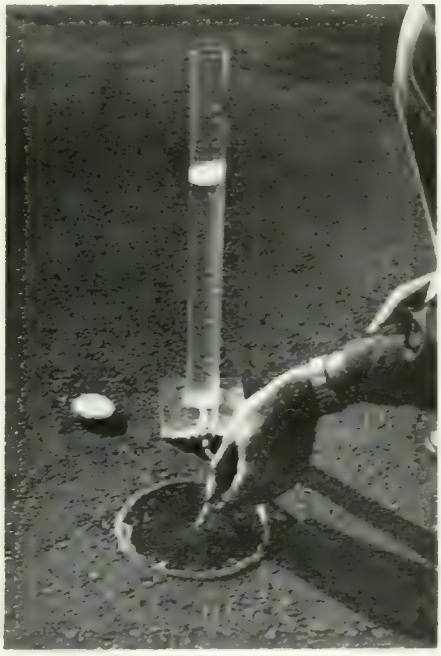


FIGURE 1B. Applying water solution to pavement surface.

It is the general assumption that the permeability of the compacted pavement and its durability are more or less proportional to the percentage of air voids. This statement should be accepted only in a general sense. Certain size dimensions of the individual voids and the lack of interconnection of the voids could produce a pavement of relatively high void content and a low permeability. In other words, low density does not necessarily indicate high permeability. In this case, it is to be expected that the hardening of the bituminous binder will progress at a relatively slow rate.

One other important phase of the permeability-void-durability relationship which should be stressed is that the above statements are generally true when the same asphalt and aggregate mixture is used. On the other hand, it should not be overlooked that the source or method of manufactur-

FIG. 2

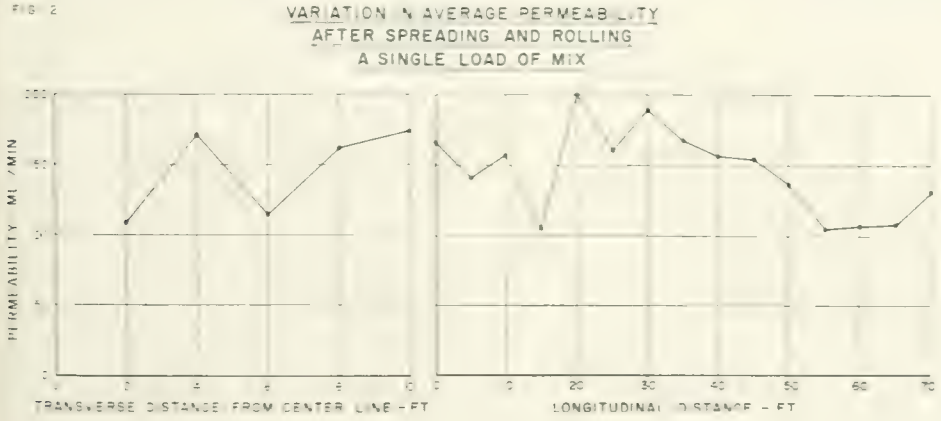


TABLE A

Permeability of Pavement Immediately After Construction Compared With Moisture Content in Pavement After Winter Rains

Permeability measurement date	Permeability ml./min.	Sample date for moisture test	Percentage of moisture pavement
Dec. 1956	10	March 1957	1.37
	10		1.50
	15		2.50
	35		2.96
	55		3.10
	105		2.69
	112		2.18
	170		3.14
	610		3.37

Average percentage of moisture in paving mixture during construction = 0.2%.

TABLE B

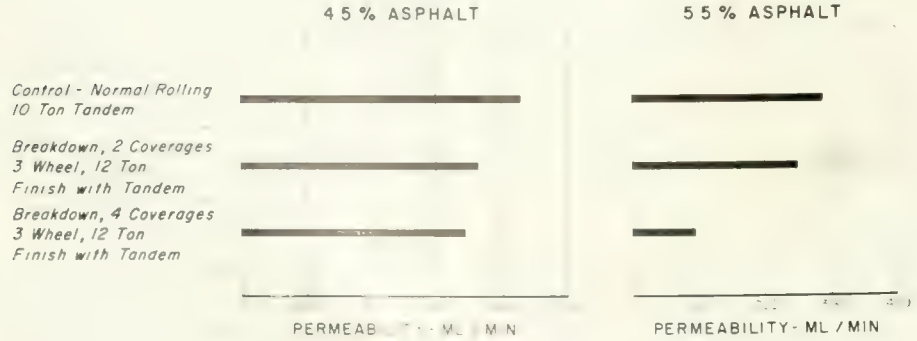
Rolling Studies

Project E

Paving date	Mix type	Test section number	Lane	Course	Type of rolling	Average rolling temperature (° F.)	Average 24-hour permeability (ml./min.)
June 1960	2½" max.	A	Passing	Base	Breakdown, 1 coverage	278	
					Finish with tandem	160	227
		B	Travel	Base	Breakdown, 1 coverage	298	
					Finish with tandem	168	162
		B-1	Travel	Base	Breakdown, 1 coverage	281	
					Pneumatic, 1 coverage	176	
					Finish with tandem	155	155
		B-2	Travel	Base	Breakdown, 1 coverage	289	
					Pneumatic, 3 coverages	168	
					Finish with tandem	155	135
	2" max.	1	Passing	Surface	Breakdown, 1 coverage	218	
					Finish with tandem	163	352
		1-1	Passing	Surface	Breakdown, 1 coverage	215	
					Pneumatic, 1 coverage	174	
					Finish with tandem	138	183
		1-2	Passing	Surface	Breakdown, 1 coverage	214	
					Pneumatic, 3 coverages	164	
					Finish with tandem	142	147
		2	Travel	Surface	Breakdown, 1 coverage	243	
					Finish with tandem	160	179
		2-1	Travel	Surface	Breakdown, 1 coverage	254	
					Pneumatic, 1 coverage	166	
					Finish with tandem	152	136
		2-2	Travel	Surface	Breakdown, 1 coverage	250	
					Pneumatic, 3 coverages	164	
					Finish with tandem	130	77

AVERAGE PERMEABILITY VALUES OF A SECTION CONTAINING DIFFERENT ASPHALT CONTENTS.

PROJECT N



ing the bituminous binder may far overshadow the effects of permeability and air voids as far as durability of the pavement is concerned.

Minimum Compaction Specified

In order to guard against excessive voids of the pavement, many organizations specify some minimum relative compaction of the finished pavement; the percentage of relative compaction being measured against some standardized laboratory compaction or in some cases against theoretical density. In order to determine this relative compaction, it has been necessary to obtain samples of the compacted mixture by chipping out blocks or obtaining a core.

Although both methods have been used with some degree of success, each has definite drawbacks. In breaking out a block, the compacted mixture is very often disturbed, which may lead to erroneous results in the specific gravity determination. When obtaining cores by drilling, water is introduced into the specimen and considerable time is required to dry the core at low temperature. This causes some delay in determining relative compaction results.

A review of existing methods and our field studies indicated that if a physical check on compaction during construction was to be possible, a rapid method of measuring relative compaction of pavement mixtures was needed. The purpose of this report is to present our studies as they relate compaction and water permeability of asphaltic concrete pavements and to discuss the factors that influence the permeability during construction and service life of the pavement. A simple test method has been developed which is equally applicable to new or existing pavements.

Test Method

In our preliminary studies, we noted that water poured on a new asphaltic concrete pavement did not readily wet the surface and very little entered the mix. Later studies showed that traffic action, together with the presence of dust on the surface, tends to change the interfacial tension relationship and water readily enters a permeable surface during the first rains. The problem of devising a test

for permeability of the surface was solved by the addition of a small amount of detergent to reduce the surface tension of the water used in the test. On a number of jobs involving a relatively impermeable base, such as cement-treated base, the values obtained by this method show good relationship between permeability and the moisture content found in the mix following rains. (See Table A.)

The method is detailed in Test Method No. Calif. 341. The general technique was originally developed in connection with seal coat studies and has been in use by this department for the past seven years.

Briefly, the test is performed by forming a small reservoir by means of a "grease ring" or dam around a previously marked 6-inch circle on the pavement, Figure 1A. The ring may be easily placed with a grease gun using ordinary cup grease, or it may be formed in one operation by a special gun. The ring grease is sealed to the surface by running the finger around the outside edge of the grease. A graduated cylinder containing the test solution and equipped with a drain tube is placed beside the ring.

Area Kept Moist

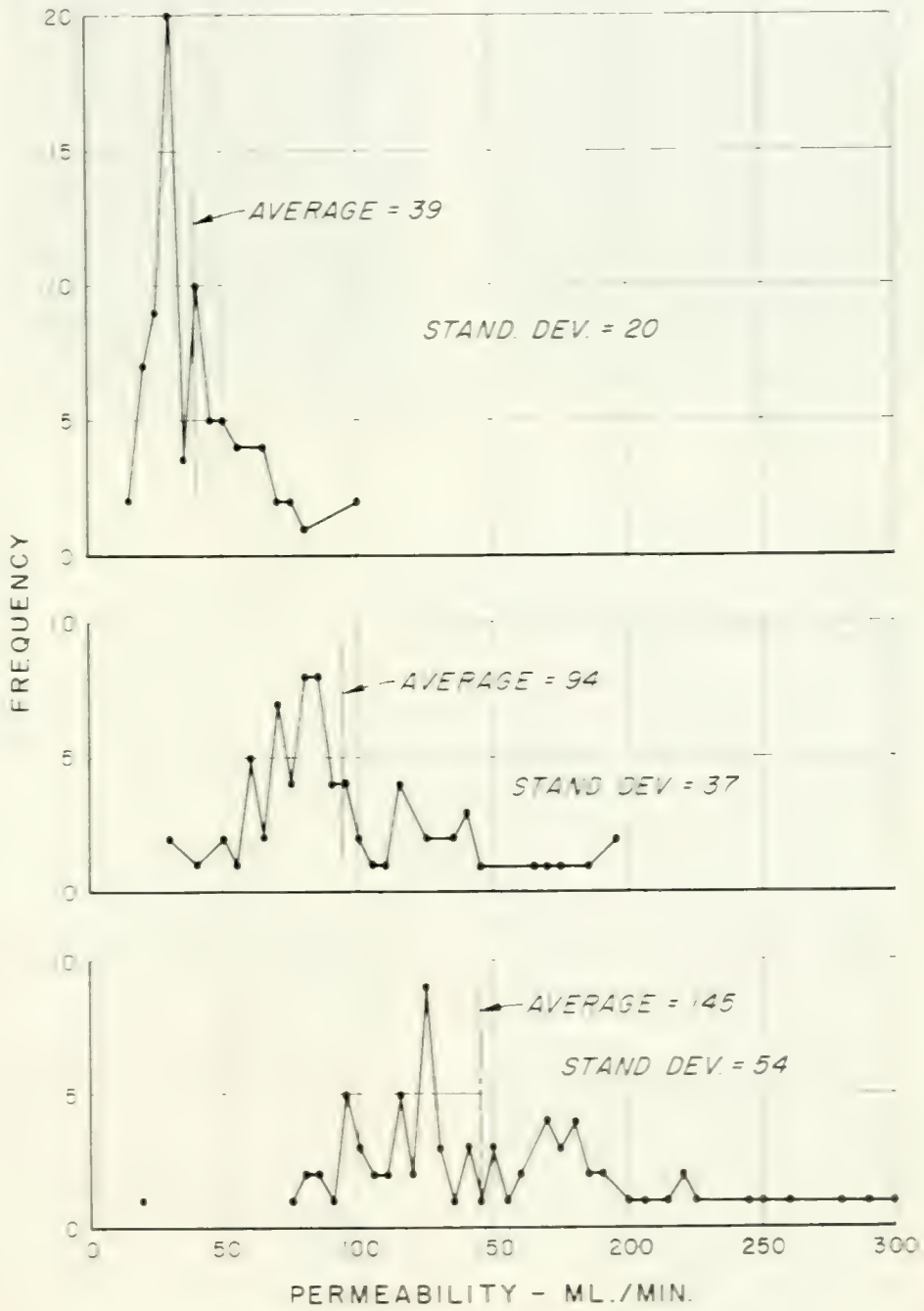
The operator feeds the solution into the area within the ring, starting a stopwatch at the start of flow of the liquid from the graduate, Figure 1B. The area within the ring is kept moist during a test period of two minutes. The film of liquid in the ring should only be thick enough to present a glistening appearance. In other words, the water is fed in only as fast as it is absorbed by the pavement and the test is conducted under zero pressure. At the end of the two-minute period the total solution used is divided by two and the permeability reported in ml./min.* for a six-inch-diameter circle. The complete test may be performed in three to five minutes.

Dense graded bituminous surfaces that are covered with an open graded mix are tested by chipping away the open graded mix, just outside of the six-inch ring, down to the dense graded surface. The ring of open graded mix removed is about one-half to three-fourths inch wide. This annulus is filled with the grease to form the seal and the permeability is determined through the open graded mix within the area of the ring. We have found it necessary to perform the test in this manner, since removal of all the open graded surface with a chisel within the ring area tends to seal the underlying surface with a glaze of asphalt and results in erroneous readings.

Successive tests are performed in the inner wheel track, midway between the wheel tracks, and in the

FIG 3

VARIATION IN PERMEABILITY AFTER SPREADING AND ROLLING A SINGLE LOAD OF MIX FROM THREE TEST SECTIONS ON THE SAME PROJECT



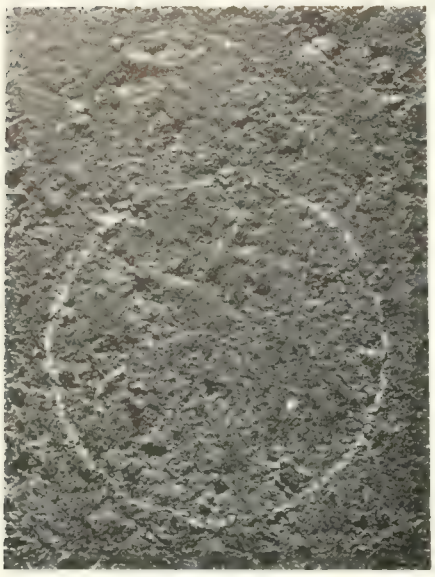


FIGURE 4A. Relation of permeability to surface texture. Penetration rate on this section was 10 millimeters per minute.



FIGURE 4B. Relation of permeability to surface texture. Penetration rate on this section was 580 millimeters per minute.

outer wheel track at 25-foot intervals. A total of six readings constitute a "set" for any one area and the average is then obtained. A series of these sets should be obtained over the length of the job.

On a multilane road, it is important to check the area between the wheel tracks in the passing lane. It has been noted that an initially high permeability of a pavement may be reduced to a satisfactory low value in the wheel tracks by traffic action. However, the between-wheel-track areas may remain relatively unchanged and water may enter here, cross-flow through the pavement, on top of the base, and collect beneath the wheel track areas.

Factors Influencing Permeability

Our field studies have uncovered a number of variables that influence the permeability of the pavement during construction and its service life.

Some of these variables are:

1. Segregation of mix during placing.
2. Temperature of mix during breakdown rolling.
3. Temperature of mix during pneumatic rolling.
4. Weight of breakdown roller.
5. Tire or contact pressure of pneumatic roller.
6. Ambient temperature during placing of mix.
7. Void content of the compacted mix.
8. Amount of traffic prior to winter rains.

Even though every effort is made to maintain uniform construction procedures, individual permeability test values may be still quite variable.

On one project the variations in a single load of mix were determined by taking readings every five feet in a longitudinal direction and every two feet transversely. This was performed for three separate loads of mix in different test sections. The average values for one load of mix are shown in Figure 2. The frequency of values for an individual load in each of three different test sections is shown in Figure 3. The results indicate an increasing spread of values with increasing per-

TABLE C

Project	Section	Rolling pattern	Temperature °F: Breakdown	Temperature °F: Pneumatic	Temperature °F: Finish	Pneumatic contact pressure (lbs./sq. in.) from Bros. chart	Permeability (ml/min) 1–3 hours after rolling	Percentage reduction by pneumatic rolling	Remarks
	1	[illegible] + finish	187	--	107		156		
H	2	Breakdown + pneumatic + finish	220	128	115	68	113	28	Breakdown and pneumatic temperatures low; pneumatic contact pressure high
			22	178	115	68	77	51	Breakdown temperature low; pneumatic temperature and contact pressure high
	1	[illegible] + finish	275		140		64		
J	2	Breakdown + pneumatic + finish	2[illegible]	188	131	62	46	28	Low permeability after breakdown
	1	Breakdown + finish	2[illegible]		130		886		
		Breakdown + pneumatic + finish	245	163	142	76	143	63	Breakdown and pneumatic temperatures high; pneumatic contact pressure high
	1	Breakdown + finish	2[illegible]		135		628		
K	2	Breakdown + pneumatic + finish	2[illegible]	135	135	34	507	19	Breakdown and pneumatic temperature low; pneumatic contact pressure low; permeability high
	1	Breakdown + finish	250		140		288		
	2	[illegible] + pneumatic + finish	250	143	140	39	228	21	Breakdown temperature high; pneumatic temperature and contact pressure low
	1	Breakdown + finish	243		140		149		
L	2	Breakdown + pneumatic + finish	255	140	115	64	59	60	Breakdown temperature high; pneumatic temperature low; contact pressure high

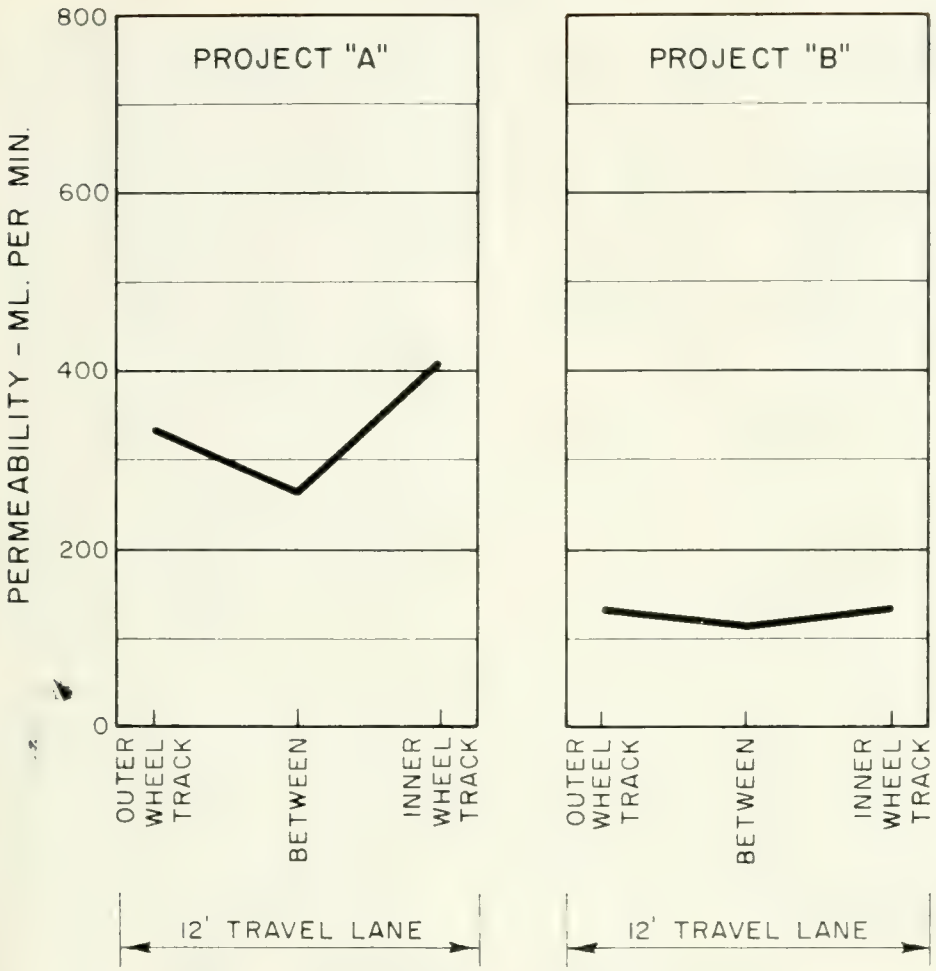


FIGURE 5. Average permeability values. End-dump paving method.

meability, with the spread being greatest for values above the average. It is necessary to obtain a sufficient number of readings to insure a reliable average reading, if it is desired to evaluate compaction by the permeability test.

Visual Inspection Inadequate

It should also be pointed out that permeability cannot be estimated by visual inspection of the surface appearance, with the possible exception of obvious rock pockets. Figures 4A and 4B illustrate the large variation in permeabilities for the same general surface texture on a particular project.

The method of placing the mixture may influence the permeability values transversely, across the lane, as shown in Figure 5. In the normal paving procedure with end dump trucks, the initial permeability is generally higher in the future wheel track areas, probably due to some segregation of the mixture near the edges by the lateral distribution device in the paver. However, this is sometimes reversed when the bottom dump method is used.

The major factor is the temperature of the mix during the breakdown and pneumatic rolling operations. The results of varying the breakdown temperatures are shown in Table B and Figures 6 and 7. Permeability values for base and surface courses having different gradings and asphalt contents, but rolled with the same equipment are shown in Figure 6. The reduction in permeability with increase in breakdown temperature is very definite for both types of mixtures. The importance of this factor is further indicated by results shown in Figure 7. The average permeability value after completion of high temperature breakdown rolling in Section 2 is almost as low as the complete rolling schedule in Section 1 where breakdown temperatures were much lower.

These results indicate that the permeability test does provide an indication of the degree of densification attained during the breakdown rolling operation.

Pneumatic Rolling

Further reduction in permeability following breakdown compaction may be achieved by pneumatic rolling. Experience has clearly indicated that traffic action is very effective in achieving a "tightening" or "sealing" of the surface and one reason for pneumatic rolling is to obtain this action during construction. The requirement for pneumatic rolling in the 1960 Standard Specifications was based on evidence that this form of rolling is an effective way to reduce permeability.

Some typical results of permeability-rolling combination studies ob-

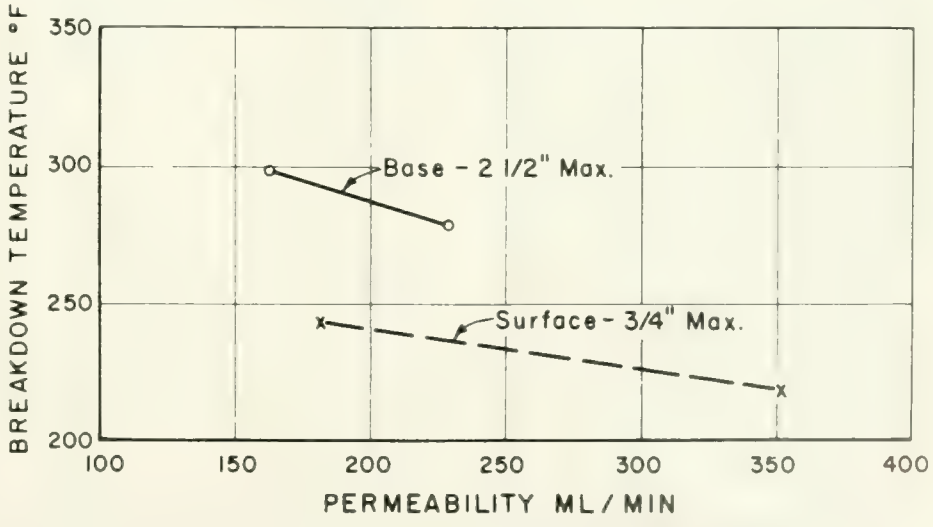


FIGURE 6. Effect of breakdown temperature on permeability. Project E.

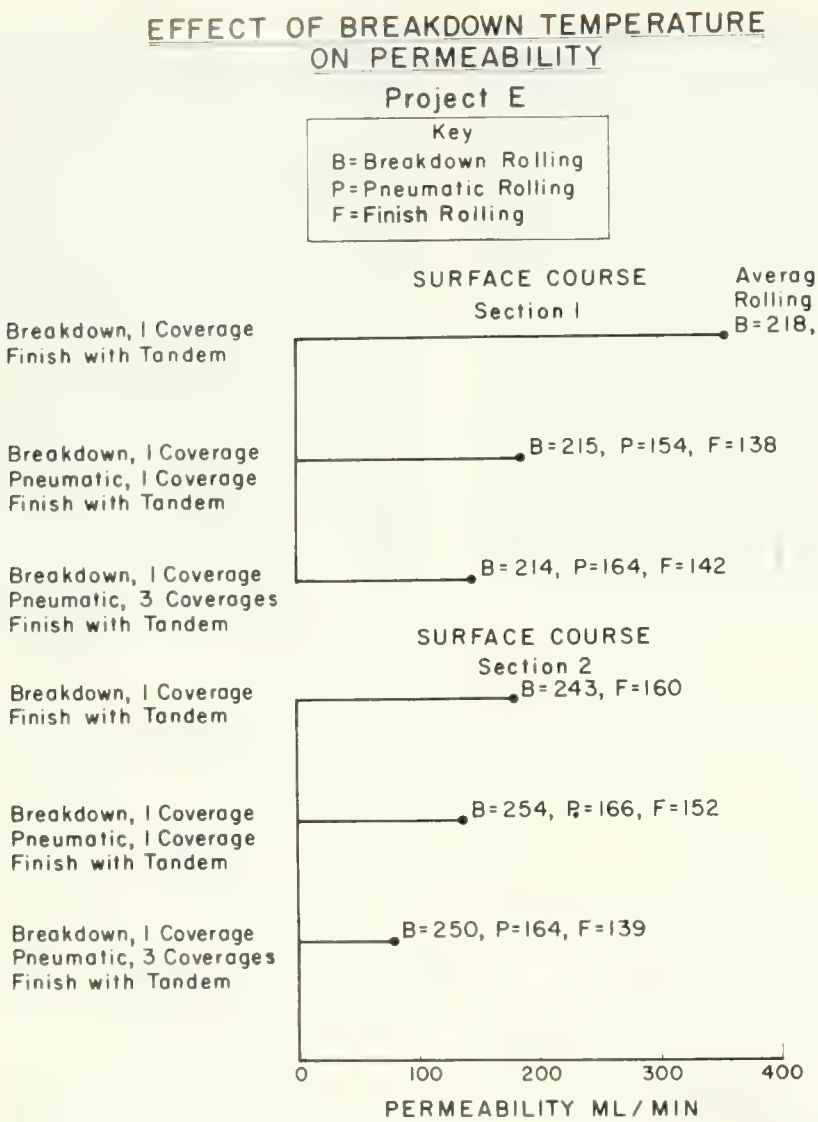


FIG. 7

tained under our 1954 Specifications are shown in Figure 8. Although we note an average reduction in permeability with increased rolling, it is not as great as would be expected. Unfortunately, our pneumatic roller tire pressures did not exceed 35 psi. However, on one project we were able to boost the tire pressure up to 50 psi and a definite reduction of about 150 ml./min. was attained when compared to the 35 psi tire pressure.

Table C shows more recent permeability values obtained with varying pneumatic contact pressures and varying breakdown and pneumatic rolling temperatures. It appears that the greatest benefit from pneumatic rolling is obtained when both the contact pressure and temperature of the mix are fairly high and when the permeability after breakdown is in the 100 to 400 ml./min. range.

Construction forces have been concerned with the problem of "pick up" and "sticking" of the mix to the tires of the pneumatic roller and have found it necessary on a number of jobs to reduce rolling temperatures in order to prevent this action and the resulting unsightly appearance of the surface. The addition of small quantities of water-soluble oil to the roller water has somewhat alleviated this condition, but it is imperative that this problem be solved if the maximum benefit is to be derived from the pneumatic roller compaction.

The workability of the mix and degree of compaction depend not only on field conditions, but also on mix design variables such as asphalt content and aggregate grading. Both variables influence the permeability values. The differences between 4.5 percent and 5.5 percent asphalt on the same grading are shown in Figure 9. It is realized that the proper asphalt content must be based on consideration of a number of factors and is limited by the stability requirements. In the case of noncritical mixes, the asphalt content is limited to prevent "flushing" of excess asphalt to the surface and thus providing a skid hazard.

It is logical to assume that the percentage of voids and the relative compaction should be related to the permeability values immediately or shortly after construction. As pointed out earlier, the permeability is a function of the number of interconnected passageways in the pavement and will vary depending on factors involved in design and construction. Further, the "sealing" of the surface by pneumatic rolling and traffic action may

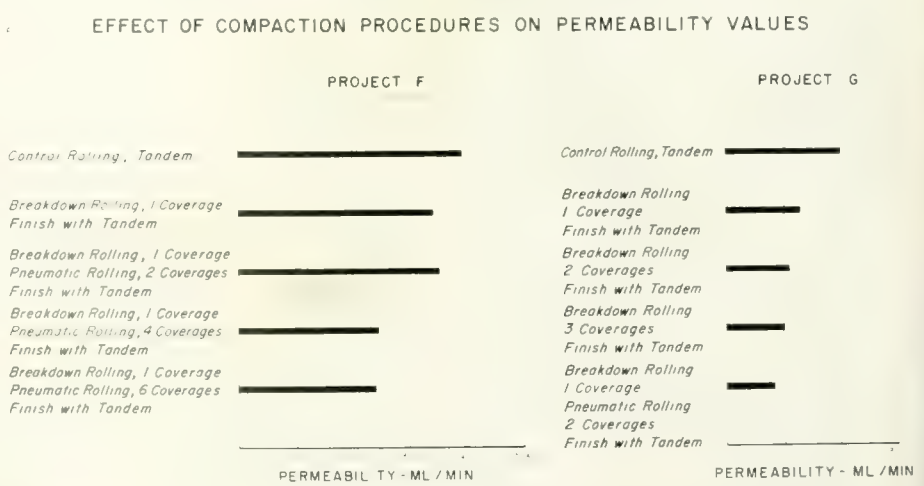


TABLE D

Field Permeability, Void Relationship for a Number of Individual Projects

	Type A— max.	200	97.4	8.8
		25	97.0	9.0
		510	93.5	12.3
	Type A—¾" max.	30	[illegible]	4.5
		[illegible]	97.0	5.8
		[illegible]	93.2	9.5
		250	94.5	8.2
		55	92.8	10.1
G	Type A— max.	15	98.3	[illegible]
		15	[illegible]	3.5
		[illegible]	[illegible]	5.0
		[illegible]	100.0	[illegible]
		4	98.3	5.0
		50	98.8	4.5
		55	97.4	5.8
		70	97.4	5.8
		8	97.9	5.4
G	Type B— max.	150	96.4	9.6
		175	96.0	10.0
		175	94.2	11.6
		195	93.8	12.1
		210	94.2	11.6
		300	94.2	11.6
H	Type B— max.	55	[illegible]	[illegible]
		150	[illegible]	10.6
		190	[illegible]	10.2
		265	91.1	12.6
		[illegible]	[illegible]	10.1
		520	[illegible]	13.4

markedly reduce the permeability measured after the breakdown pass while not materially reducing the total void content of the pavement.

Cores Are Removed

The relation between void content and permeability was measured on a series of jobs by determining the permeability 24 hours after completion of rolling. Cores were then removed from areas of different permeability values and the density and percentage of relative compaction were determined, with 100 percent relative compaction assigned to a laboratory compacted specimen. Results are shown in Table D and Figures 10 and 11. The curve for the void-permeability relation indicates that there is no serious change in permeability up to about 10 percent voids. However, even small increases in void content above this figure show a marked increase in permeability. A similar relationship is found when the percentage of relative compaction falls below 94 percent, Figure 11.

As will be shown later, the permeability of pavements laid during the summer paving season show a marked decrease due to traffic action. This decrease is not accompanied by any pronounced reduction in void content since only the uppermost portion of the surface course is "sealed" by this action. However, pavements laid in the late fall cannot be expected to "seal"

FIG. 10

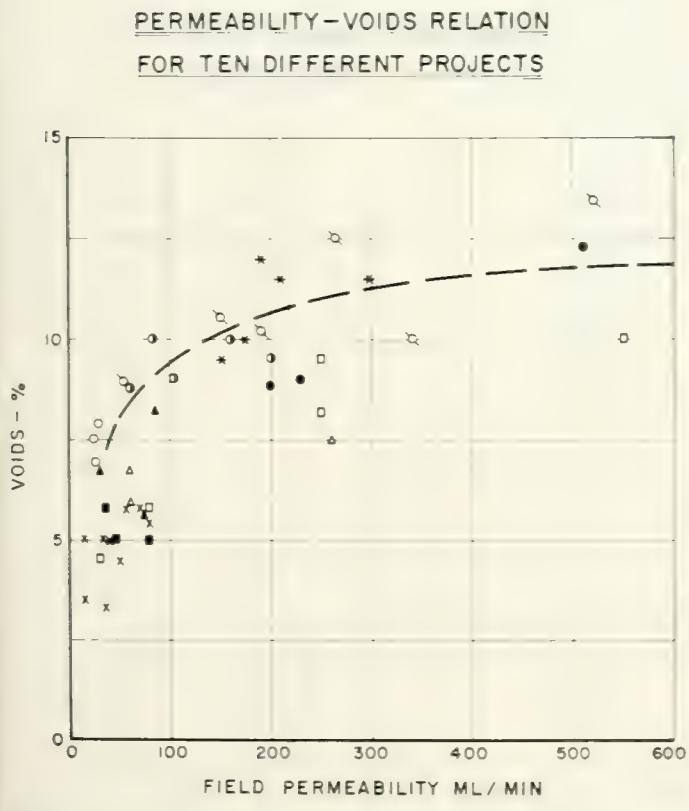
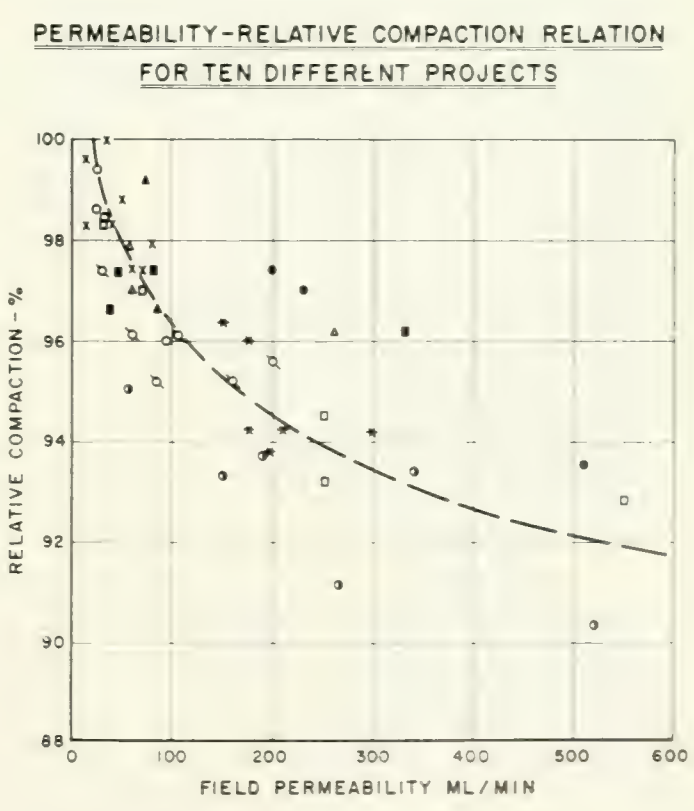


FIG. 11



prior to winter rains. The void-permeability curve clearly indicates that excessive water may enter the pavement if compaction procedures during construction are not effective in reducing the void content to a safe level.

Reduction Pattern

There is a reduction in permeability during at least the first 24 hours after completion of rolling, Figure 12. This is best accounted for on the basis of "cold-flow" of the binder since the test section was not subjected to any traffic. It is reasonable to infer that a number of original interconnected passageways are sealed by the slowly continuing movement and adjustment of the asphalt binder.

The importance of traffic action is shown in Figure 13. This striking reduction in the permeability of all areas of the roadway to a very uniform and low level has been found on a number of jobs during the early summer and subjected to traffic during warm weather. In contrast on another job, paved in December, we found no reduction in the initially high permeability values until the following summer.

During the late fall and winter paving, the lower atmospheric temperatures are a definite handicap in attaining proper compaction. Even elevated mixture temperatures and immediate traffic action will not satisfactorily knead or seal the surface of the pavement to prevent entrance of water. Increasing the mixing temperature may have, in some cases, an immediate effect on the compaction, but at the same time may harden the bituminous binder sufficiently to effect a marked lowering of the service life of the pavement. Table E shows permeabilities obtained during paving operations in September and October-November on the same project. The September permeabilities average about 47 ml./min. against 371 ml./min. for the October-November values.

Early Winter

An interesting illustration of the change in permeability of a pavement laid in the early winter season is shown in Figure 14. This pavement was laid during low atmospheric temperatures and was not subjected to

TABLE E

Average Permeability Values for a Pavement Constructed During Changing Climatic Conditions

Paving	Atmospheric temperature range during paving		Average permeability (ml./min.)
	Maximum	Minimum	
September	87	51	47
October–November	56	35	371

TABLE F

Reduction in Permeability Values Following Application of a Slurry Seal

Project Q

Test condition	Station	New pavement thickness	Permeability (ml./min.)				
			Travel			Passing	
			Shoulder	O.W.T.	B.W.T.	B.W.T.	O.W.T.
New pavement immediately after completion, November 1957	603+00	2"	310	70	110	270	--
	603+25			100	130	140	
	604+00		260	90	90	320	
	606+50		230	90	100	270	--
	608+00		400	270	340	320	
	Average		300	124	154	264	--
	589+00	3"	--	--		700	
	590+00		--	--	500	480	
	591+00				320	440	--
	591+89				400	500	--
	592+00			--	420	490	--
	593+00		--	--	360	--	--
	593+50		--	--	--	500	
	594+00				360	350	
	Average			--	393	494	
	596+00	4"	--	--	250	--	
	597+00		--	--	230	--	--
	598+00		--	--	500	--	--
	599+00		--	--	350	--	--
	600+00		--	--	750	--	
	601+00		--	--	440	--	
	Average		--	--	420	--	--
New pavement plus slurry seal immediately after completion, November 1957	604+00	2"	--	10	10	10	
	604+25			10	10	10	
	606+00			10	10	10	
	606+50			10	10	10	
	Average			10	10	10	--
	593+50	3"	--	10	10	10	
	593+75		--	10	10	10	
	Average		--	10	10	10	
	598+00	4"		10	10	10	
	598+25			10	10	10	
	Average			10	10	10	
New pavement plus slurry seal, February 27, 1958, 151 days	604+00	2"					--
	604+25					--	
	606+00			10	10	20	10
	606+50			5	10	15	10
	Average		--	7.5	10	17.5	10
	593+50	3"	--	10	10	20	15
	593+75		--	15	10	10	15
	Average			12.5	10	15	15
	598+00	4"		10	20	20	15
	598+25			10	10	10	15
	Average		--	10	15	15	15
New pavement plus slurry seal, May 25, 1958	593+50	3"		10	10	10	10
	593+75			10	15	15	10
	Average			10	12.5	12.5	10
	606+50	2"	--	10	10	10	--
	606+75			5	10	15	--
	Average		--	7.5	10	12.5	

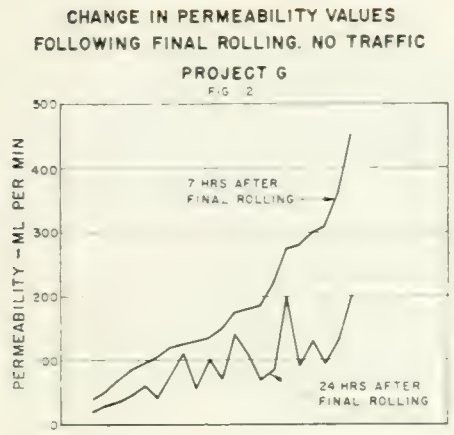


Chart right. FIGURE 13. Change in permeability of travel lane after summer traffic.

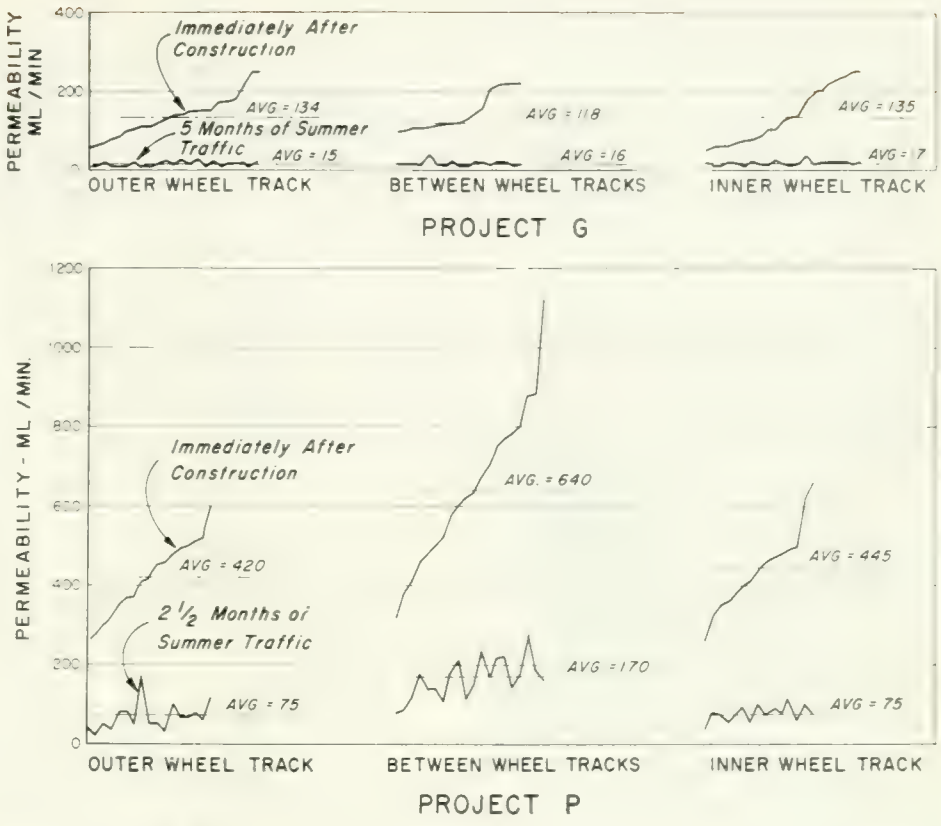
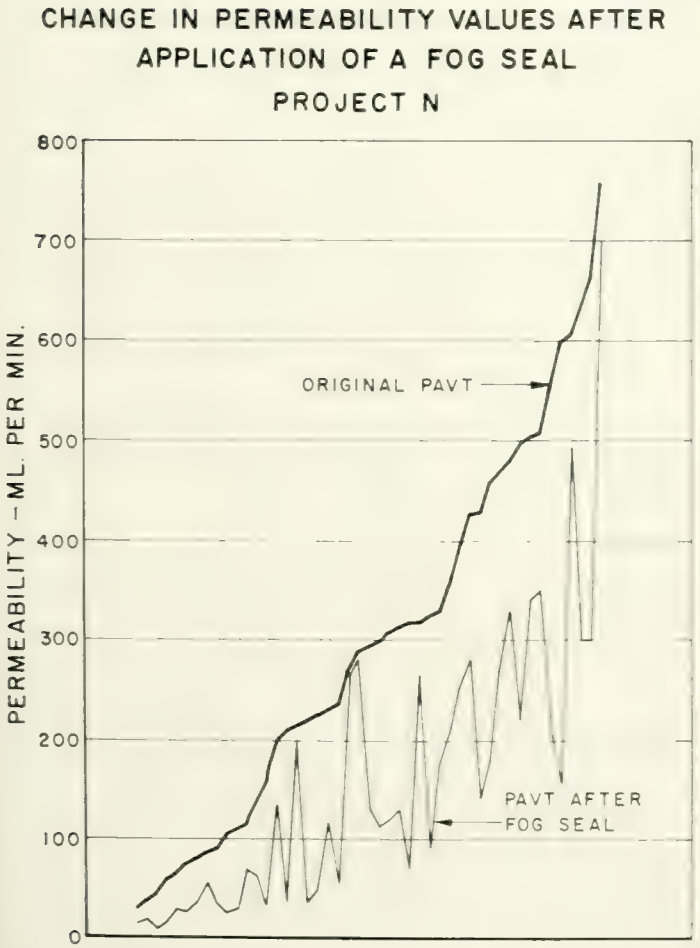
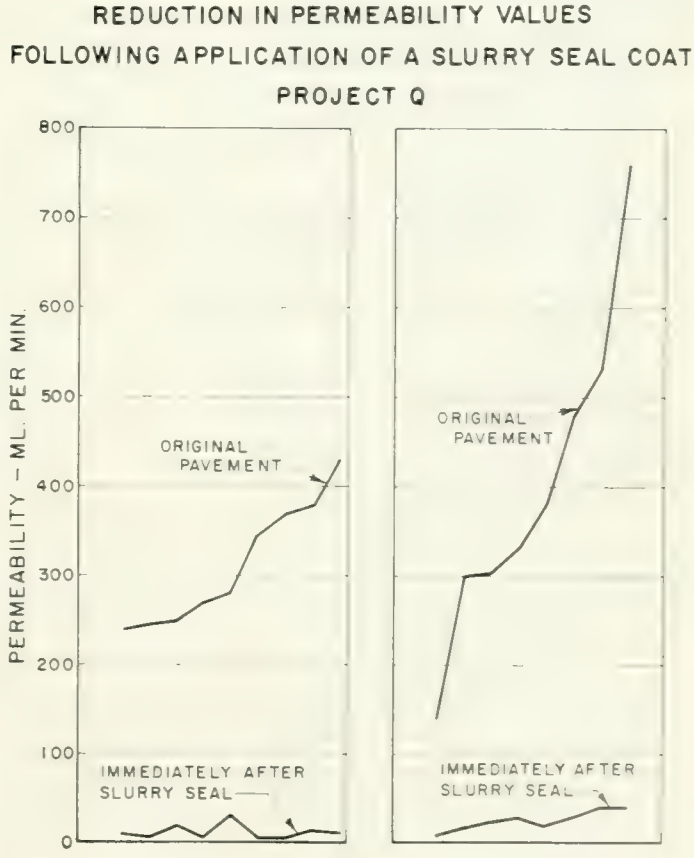


FIG. 15

FIG. 16





traffic until the following spring. The pavement was laid over a virtually impermeable cement treated base. In February 1958 after a series of storms we noted an overall drop in permeability from that found after fog sealing. This was most likely caused by entrance and entrapment of rainwater within the pavement and was further confirmed by the gain in permeability values after a period of dry weather. The increase was probably due to the evaporation of pavement moisture. A decrease in permeability values occurred after opening of the pavement to traffic.

The Materials and Research Department has consistently maintained that cold and inclement weather is the most adverse factor affecting success or failure during the placing of any type of bituminous pavement or seal coat.

Based on California weather conditions, particularly in the northern part of the State, we have suggested the following tentative schedule for placing bituminous pavements or seal coats:

(a) Seal coat construction using emulsified asphalts should be terminated by September 15th.

(b) Seal coat construction using cutback asphalts of the rapid curing type may be extended until October 15th.

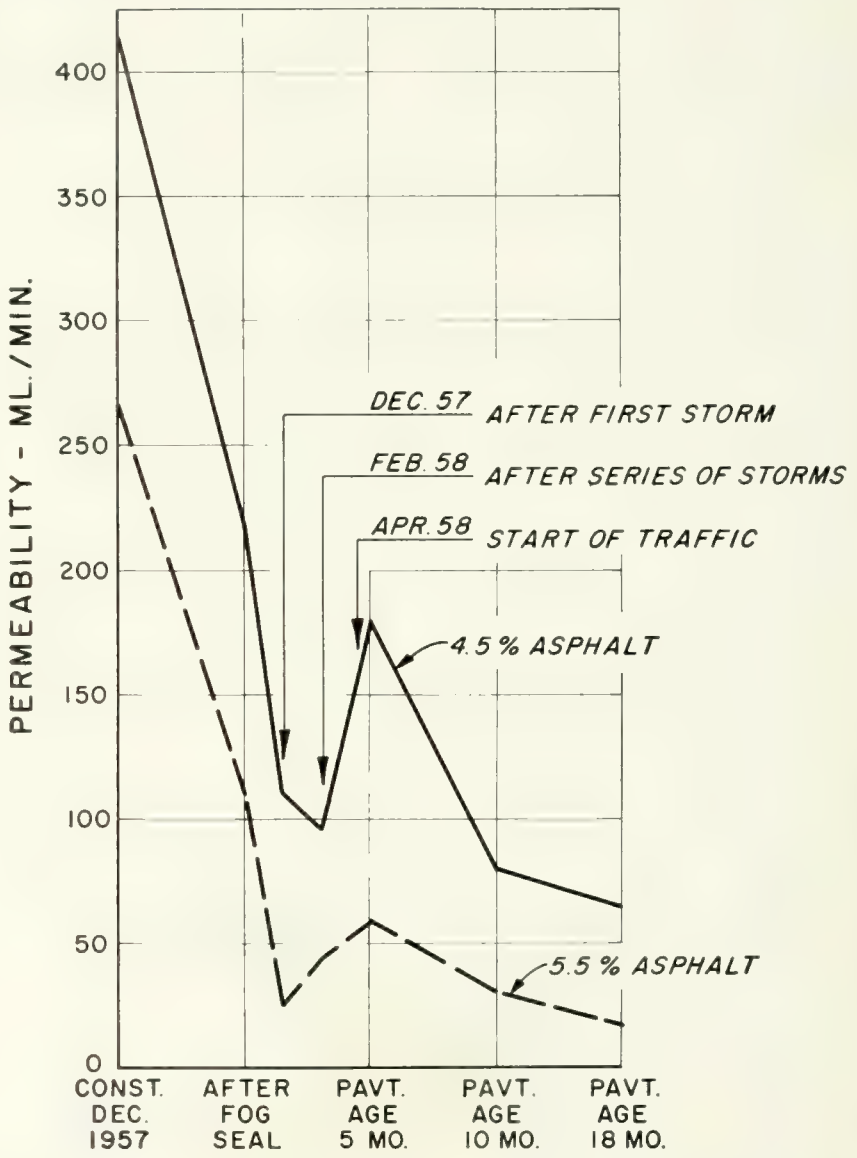
(c) Asphaltic concrete mixes, both open and dense graded, may be placed until December 1st, although a November 15th deadline would be preferable.

Our studies have shown that the normal fog seal will only be effective in sealing a pavement if the original permeability is fairly low. Figure 15 shows the reduction in permeability by the application of a fog seal. (Readings were obtained before and after fog sealing at identical spots.) We note that the permeability after fog sealing tends to parallel the original curve. It is logical to assume that passageways with relatively large diameters will not be sealed by the application of a small amount of asphalt and, therefore, in areas of high permeability no real improvement will be noted.

FIG. 14

CHANGE IN PERMEABILITY VALUES CAUSED BY INCREASE AND DECREASE OF PAVEMENT MOISTURE AND TRAFFIC COMPACTION

PROJECT N



On the other hand, a slurry seal or screening seal coat virtually renders the pavement impermeable. (See Table F and Figure 16.) Present data indicate that such seals completely prevent the entrance of surface moisture. Unfortunately, it is very difficult to attain a satisfactory job with either of these types of seal coats during cold or rainy weather although during this paving period newly laid pavements are most in need of some form of sealing.

Tentative Limits

We believe that a tentative average water permeability value not exceeding 150 ml./min. for a 6-inch-diameter area will be low enough to prevent the entrance of excessive moisture into the pavement from the surface. On the basis of our studies, we have concluded that it is not feasible or even advisable in all cases to attempt construction of a completely impermeable asphalt pavement, because to do so would in many instances require sac-

rificing other qualities of importance equal to the water problem. Our objective is to reduce the potential for water infiltration to a minimum through properly designed mixes and practical construction methods. The permeability test is a useful tool in attaining this desirable end result.

It should be pointed out that the figure of 150 ml./min. is a relative test figure only and indicates the ability of the newly compacted or existing pavement to accept water. Once the voids in the pavement are filled with water the amount of any additional water admitted depends on the permeability or porosity of the base material.

Conclusions

A simple and rapid test method for measuring the tendency of surface water to enter an asphaltic pavement has been developed.

This test can be used during actual construction to give an indication as to the effectiveness of compaction operations.

The results of field studies clearly indicate that pavements, even of the so-called dense graded mixtures, have been constructed that are quite permeable to the entrance of surface water. This water may contribute to possible failure of the pavement by acting as the agent for transporting base dust and clay fines into the interstices of the pavement mixture. This action may also contribute to the rapid hardening of the binder, especially in the lower part of the pavement.

Field tests indicate that adequate compaction, together with some form of pneumatic rolling are very important factors in reducing pavement permeability. Also, permeability may continue to decrease immediately after construction and will definitely decrease for pavements laid during the normal paving season when subjected to traffic during the summer months. On the other hand, pavements laid during the late fall or winter must rely on adequate initial compaction since no further decrease in permeability may be expected before the following summer. Bituminous pavements or seal coats should not be placed in the late fall or during the winter months.

Fog seals will decrease the permeability but will not prove effective if the initial permeability is very high. Slurry seals and screening seal coats effectively reduce the permeability value to a very low figure.

Some of the early studies involving relatively permeable surfaces were conducted on pavements constructed under the 1954 Standard Specifications. As the result of these studies, the 1960 Standard Specifications carry more rigid requirements for temperature control and additional compaction equipment.

More recent studies on a considerable number of projects show a marked decrease in permeability values and void content of the mix. This, of course, should provide better durability for the bituminous binder with a resulting longer service life for the pavement.

Twenty-five-year List

The following employees received their 25-year awards during April, May and June:

Headquarters Office

Charles G. Beer
Lyman R. Gillis
George A. Hill
Dwight J. Morrow

State-owned Toll Bridges

Theodore Hubbard

District I

W. Sam Burrows

District III

Ida V. Chase
Arthur C. Kehm
H. E. Nahhas
Clarence E. Walters
Leonard V. Wood

District V

Charles W. Dana

District VI

Harold E. Breckenridge

District VII

Edith Berg
John D. Groff
Maxine Thacker

District VIII

Freda Reed Dunbar

District IX

Dorothy Vellom

District X

John Christensen

District XI

Vernon H. Hamby
Glenwood L. Richardson

McCorkle Retires, Plans Boat Trip

Nathan C. McCorkle, assistant planning engineer, retired July 11 after a career of 34 years with the Division of Highways.

His work during the last 10 years was in a liaison capacity with various districts. He was associated with the route studies and design for highway projects in most parts of the State, including many of the major freeways in the Los Angeles and San Francisco Bay areas.


N. C. McCORKLE

McCorkle was born in Seattle April 12, 1902, and received his education in that city. Between 1920 and 1930 he had engineering assignments covering the Pacific Coast from Alaska to the Mexican border. He joined the Division of Highways as a draftsman in Bishop and transferred to Sacramento in 1931. He moved to Eureka in 1936 where he served for three years as resident engineer on highway construction projects.

McCorkle and his wife, Dorothy, have three children.

He is a member of the American Society of Civil Engineers and the Commonwealth Club of San Francisco.

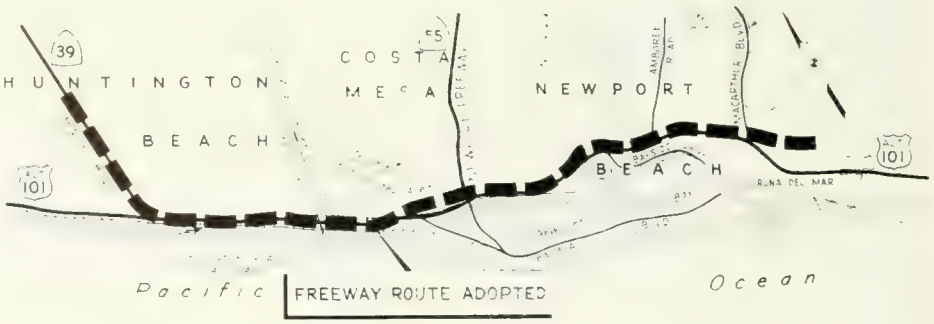
The McCorkles are planning a cruise on a 34-foot auxiliary ketch they are building and which will be launched some time this fall. With a crew of one or two to assist, they will sail down through the Panama Canal and then up the east coast of the United States.

New Routes

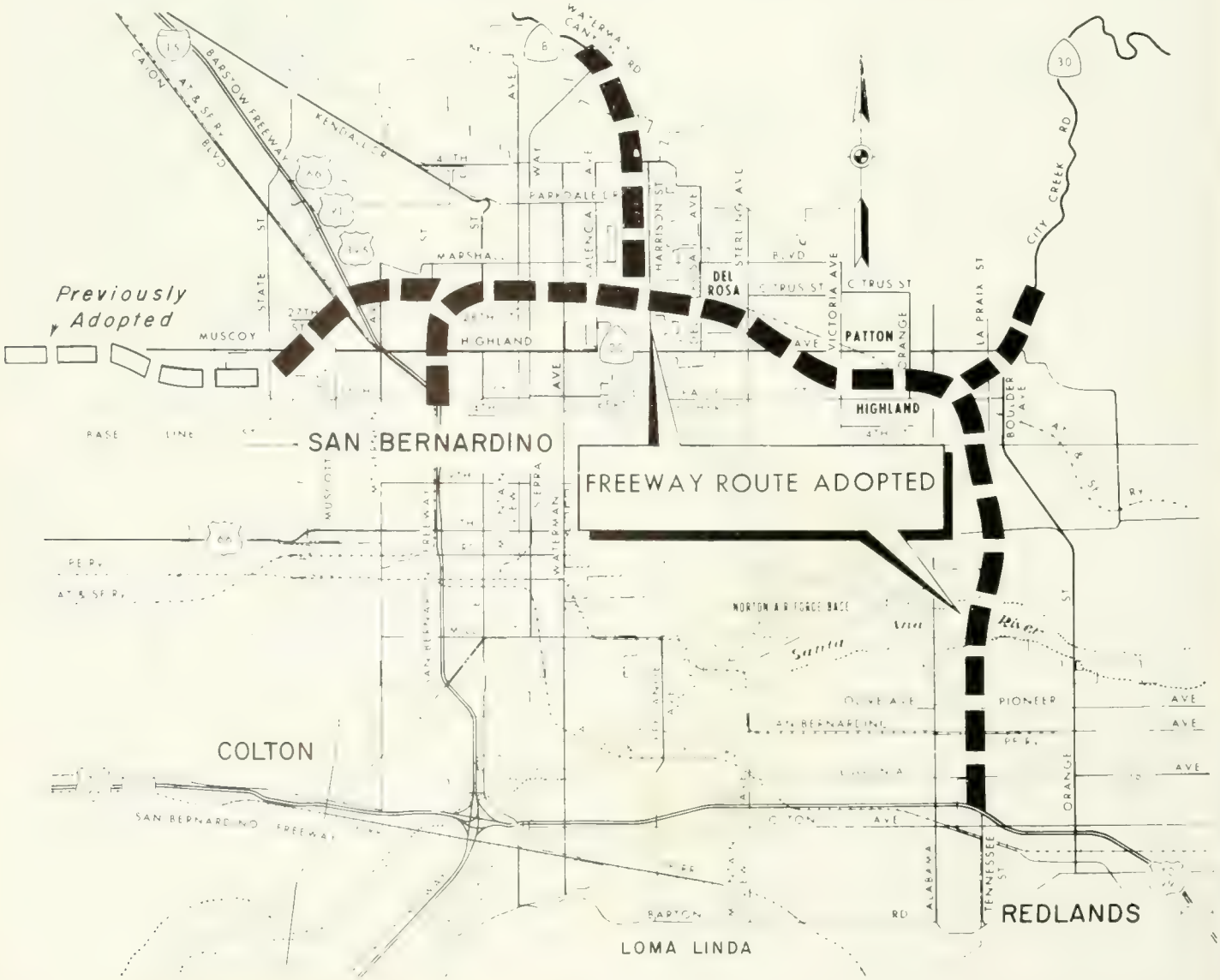
Freeway Network Adopted In San Bernardino Area

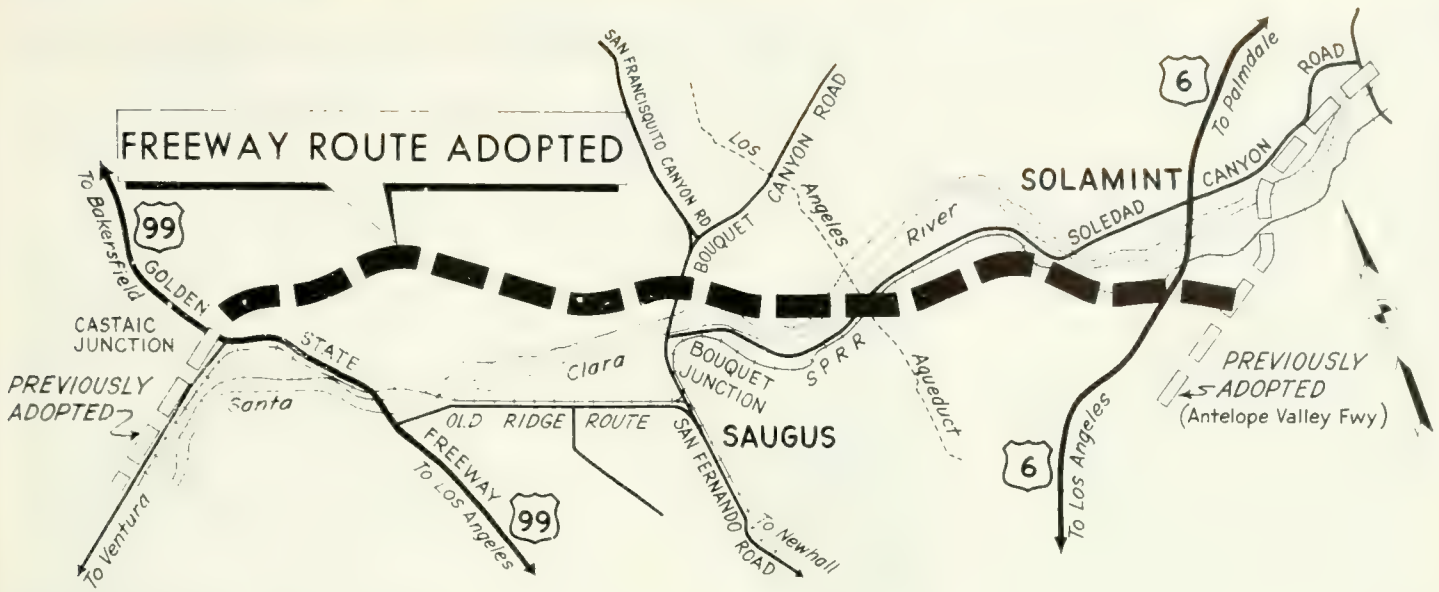
The California Highway Commission adopted eight freeway routings at its May and June meetings, including a routing for the Pacific Coast Highway in the Newport Beach-Huntington Beach-Costa Mesa area and routings for a freeway complex in and near San Bernardino.

The routing for the Pacific Coast Highway extends 10.2 miles between 0.8 mile south of MacArthur Boulevard, southeast of Newport Beach, and north of Adams Avenue in Huntington Beach.



The route generally follows the existing highway except for a slight inland shift in the Newport Beach area. In adopting it by a five-to-two vote the commission overruled a recommendation for a route farther in-





land submitted by State Highway Engineer J. C. Womack.

Three Highways Involved

Three state highways are involved in the San Bernardino area action. The adopted routes are as follows:

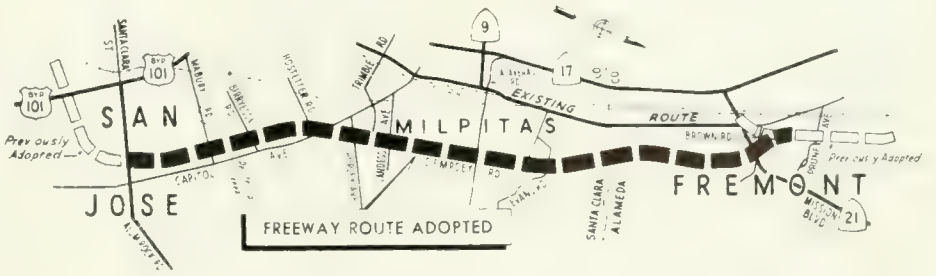
State Highway Route 190, 12.4 miles between State Street in Muscoy and U.S. Highway 70-99 (Interstate 10) in Redlands. From State Street the adopted route swings north of State Sign Route 30 (Highland Avenue) and runs easterly generally parallel with 30th Street to Del Rosa Avenue. It then swings southeast, crosses Highland Avenue east of Sterling Avenue, and continues eastward to La Praix Street. From there it runs almost directly south to Redlands, and terminates at the Interstate 10 Freeway.

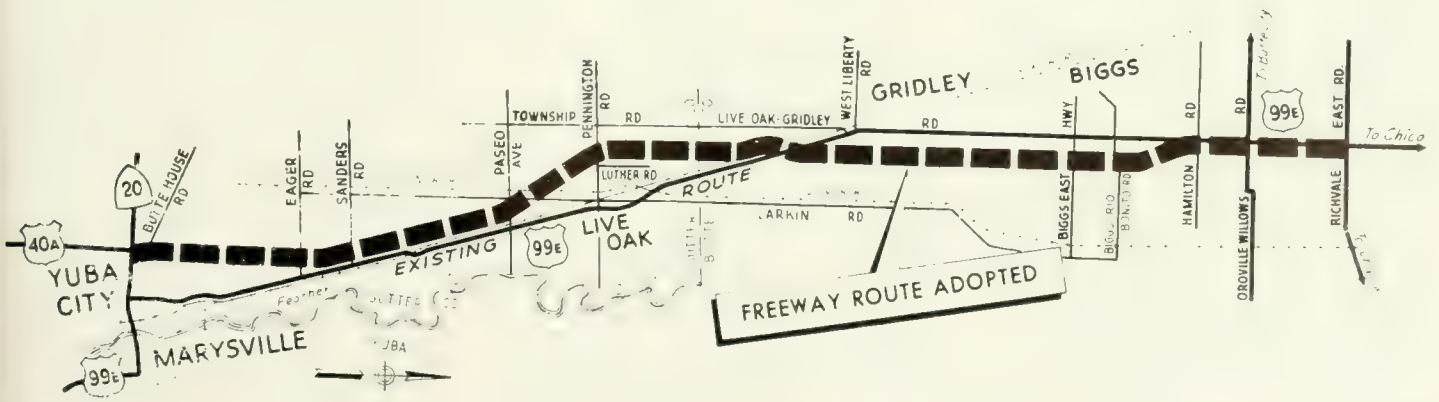
State Highway Route 43 (Sign Route 18), four miles between the San Bernardino Freeway at 16th Street and the adopted route for



Highway Route 190, and between the adopted route for Highway Route 190 and Waterman Canyon Road.

The adopted route for Highway Route 43 runs north from the San Bernardino Freeway at 16th Street to





proposed Route 190 near E Street, follows proposed Route 190 east to Harrison Avenue and then runs north to Waterman Canyon Road.

Connecting Route

State Highway Route 207 (State Sign Route 30), one mile between proposed Route 190 and 0.2 mile north of Highland Avenue. The adopted route runs northeasterly from proposed Route 190 in the vicinity of Pacific Street to form a connection from proposed Route 190 to existing Sign Route 30 (City Creek Road).

Other freeway route adoptions:

Humboldt County—for 0.7 mile of Sign Route 96 between U.S. 299 in the town of Willow Creek and 0.7 mile northerly. The route will provide for construction of a new bridge across Willow Creek and approaches.

Los Angeles County—for 9.4 miles of State Highway Route 79 between the Golden State Freeway (U.S. 99) near Castaic Junction and the adopted route for the Antelope Valley Freeway south of Solamint.

Riverside County—a revised routing for 1.7 miles of State Highway Route 193 in the vicinity of Corona.

San Luis Obispo County—for 26.1 miles of Sign Route 41 between Sign Route 1 near Cambria and U.S. 101 near Paso Robles.

Santa Clara and Alameda Counties—for 11.1 miles of State Highway Route 5 in the counties and the cities of San Jose, Milpitas and Fremont. The route extends between Alum Rock Road and 0.4 mile south of Prune Avenue in Fremont.

25-mile Routing

Sutter and Butte Counties—for 25.3 miles of U.S. Highway 99E from Yuba City to the vicinity of Evans Reimer Road south of Gridley.

Two conventional highway routings also were adopted. They are for realignment of 0.6 mile of U.S. 101 at Red Hill Curve about two miles south of Laytonville, Mendocino County, and for the realignment of portions of Sign Route 6 in Siskiyou County between 0.2 mile south of Ti Creek and Dillon Creek, a distance of 4.3 miles.

N. C. RAAB'S ENGINEERING CAREER SPANS 40 YEARS

Norman C. Raab, projects engineer of the Division of San Francisco Bay Toll Crossings, retired from State service effective July 31, 1963, after a 40-year career in bridge design and construction.

For the past 12 years Raab has been chief of the division and responsible for major toll bridge studies and developments in the San Francisco area, including construction of the Richmond-San Rafael Bridge, the remodeling of the San Francisco-Oakland Bay Bridge, and the reconstruction and widening of the San Mateo-Hayward Bridge.



NORMAN C. RAAB

He has also been in charge of planning studies for a Southern Crossing of the Bay south of the San Francisco-Oakland Bridge and for a proposed San Francisco-Marin crossing.

Raab, a native of Stockton, served as a midshipman in the U.S. Navy in World War I and was graduated from the University of California in 1921. He received his M.S. in Engineering there in 1923, and soon afterward joined the Division of Highways Bridge Department. One of his major design projects was the Bixby Creek Bridge on State Sign Route 1 in Monterey County.

He was assigned in 1931 to a Bridge Department unit being organized in San Francisco to design the San Francisco-Oakland Bay Bridge and took part in its construction. He resumed bridge design work in Division Headquarters in Sacramento in 1939, and in 1948 returned to the Bay area as design engineer for the newly formed Division of San Francisco Bay Toll Crossings. He succeeded Ralph A. Tudor as chief of this division in 1951.

His first major project for the California Toll Bridge Authority was the planning, design and construction of the double-deck Richmond-San Rafael toll bridge, which was completed in 1956 at a total cost of $64,000,000.

In 1958 he undertook the remodeling of the San Francisco-Oakland Bay Bridge to convert it to five-lane unidirectional traffic flow on each deck, including removal of the Key System rails on the lower deck; remodeling of the Transbay Transit Terminal for bus operation; and the lowering of the upper deck level through the Yerba Buena Island tunnel to make it passable for trucks. This $35,000,000 overall project is nearing completion. It was carried on without major interruptions to the 100,000-plus daily flow of vehicles across the structure.

The major job currently in progress for the division is the reconstruction of the San Mateo-Hayward toll bridge to provide four lanes of traffic instead of two on its long trestle section and to replace the existing two-lane lift span with a high-level fixed span carrying six lanes of traffic. Most of the trestle work has been completed and the substructure contract for the high-level span was awarded on July 5. Total cost of the overall project is estimated at $70,000,000.

In addition, Raab has directed several bridge planning studies in the Bay area as called for by the Legislature. His most recent study projects were an updating of previous studies on a proposed Southern Crossing and a traffic study in connection with proposals for a San Francisco-Marin County crossing.

Raab and his wife live in Berkeley. They have two daughters and nine grandchildren.

LARGE CONTRACT AWARDED

The State Department of Public Works has awarded a $6,480,000 contract for grading and paving 8.5 miles of four-lane freeway on State Sign Route 126 between one-tenth mile west of Wells Road and seven-tenths mile east of the east city limit of Santa Paula. The project adjoins a recently completed freeway section from Ventura to Wells Road.

Included in the project is construction of an Acacia Road Interchange at the junction of State Sign Routes 150 and 126, and a structure taking the Southern Pacific railroad tracks over the freeway at Todd Road.

L. L. Funk Retires; Pengilly Appointed

L. L. Funk, planning engineer for the Division of Highways, retired on July 1 after a 34-year career with the division, which has brought him widespread recognition in his profession. Succeeding him is Dana G. Pengilly, assistant planning engineer.

Funk was appointed planning engineer in 1959 and had statewide responsibility for highway planning, including such difficult freeway locations as the network through Sacramento, Beltline Interstate 805 in San Diego and Beltline Interstate 280, an extension of Junípero Serra Freeway south of San Francisco.



L. L. FUNK

Was Task Force Chief

Prior to becoming planning engineer Funk was chief of a task force which planned the route of Interstate 5, the Westside Freeway, California's longest stretch of interstate highway, extending from Wheeler Ridge south of Bakersfield to Woodland.

Funk was appointed photogrammetric engineer for the division in 1956. In 1959 he won the national Talbert Abrams Award "for authorship and recording of current and historical engineering and scientific developments in photogrammetry."



DANA G. PENGILLY

Funk was born in Chicago, attended high school in Sheridan, Oregon, and received his civil engineering degree at Oregon State College in 1921. He was first employed by the Division of Highways in 1923 as a draftsman in its Dunsmuir office.

Rejoined State in 1931

He left state service in 1925 to spend six years in mapping and tax appraisal work involving aerial photography. In 1931 he re-entered Division of Highways work in San Luis Obispo, advancing to the position of assistant district engineer — planning, before his transfer to Sacramento.

Funk is a member of the National Society of Professional Engineers, the American Congress of Surveying and Mapping and the American Society of Photogrammetry.

Pengilly has been a member of the division's Planning Department staff since January 1958 and for the past year was Funk's chief assistant.

Service in South Pacific

He is a native of Stockton and an engineering graduate of the University of the Pacific. He spent a year with the U.S. Corps of Engineers in construction of military bases in California, and then 3½ years as an aircraft maintenance officer with the Air Force in World War II, including service in the South Pacific.

He joined the District X office of the Division of Highways in Stockton in August 1946 and was associated with the design of freeway and expressway improvements to U.S. 50 and U.S. 99 in San Joaquin, Stanislaus and Merced Counties.

In November 1955 he was promoted and transferred to Division Headquarters in Sacramento as an assistant traffic engineer, and moved to the Planning Department a little more than two years later.

IN MEMORIAM

Headquarters Office

Katherine G. Foote, Intermediate Clerk.

District III

Jesse E. Colt, Highway Engineering Technician I; John Benson, Highway Landscaping Leading Man, retired.

District IV

Martin W. Judge, Highway Foreman.

District VII

Donald W. Bamford, Highway Maintenance Man II; Raymond E. Hylton, Highway Maintenance Man III.

District X

Harold R. Nelson, Highway Maintenance Man III.

District XI

John M. Jaynes, Engineering Aid II; Edward W. Shedaker, Highway Foreman; Arnold H. Lenox, Engineering Aid II.

James Spence Leaves District IV Office

James A. Spence, assistant district engineer of the Division of Highways District IV office in San Francisco, retired on July 1. He came to work for the division in 1929 at San Luis Obispo.



JAMES A. SPENCE

Spence was born at Elko, Nevada, and received his civil engineering degree from Montana State College. Following his graduation he did exploration and flood control work for the United Fruit Company in Guatemala after which he returned to the States and worked with the U.S. Corps of Engineers.

After joining the State Division of Highways in 1929 Spence was transferred two years later to the San Bernardino area where he was resident engineer on various highway construction jobs. He was assigned to the San Francisco-Oakland Bay Bridge staff in 1933, first on triangulation and surveys, later on construction.

Spence joined the District IV office in 1937. From 1940 to 1942 he was district right-of-way engineer. Since 1942 he has been engaged in various phases of highway design including most of the major freeway projects in the San Francisco Bay area.

He was appointed assistant district engineer in 1949.

Spence is married and has two sons. He has been active in Boy Scouts serving both as committeeman and explorer counselor.

District Library

San Bernardino Office
Forms Reference Unit

By ALICE VAN BOVEN, Assistant Highway Engineer



The District VIII Library, located in the district office building in San Bernardino in a room 16 by 13½ feet, contains bookcases occupying 24 feet of wall space, a reading table, and comfortable chairs. It is strictly a reference library for highway employees.

The card catalogue lists about 1,300 books and pamphlets, all classified in the Dewey decimal system. The library contains books and pamphlets on highway engineering (the majority of the books are in this category), general engineering, mathematics, surveying, hydrology and other sciences, administration, supervision, management, legal matters, area planning, drafting, and a few other miscellaneous subjects.

Approximately 50 different magazines are received by the library regularly. A few are kept on permanent file, such as those published by the State, the Bureau of Public Roads, American Association of State Highway Officials, or the Highway Research Board; the others are placed on the shelves for from 6 to 12 months. When these are discarded, they are sent to the supervisor of elementary education in the local public schools office, as teachers often use them in classroom work.

A small looseleaf notebook is maintained to aid the engineers in finding magazine articles on subjects they need. From this, the supervisor of drafting service can quickly find articles on scale models; the Production Control Department can find articles on the critical path method in a number of magazines without looking through scores of magazines piled on the shelves; the Maintenance Department can quickly refer to articles on the use of epoxies; the Traffic Department can find a list of recent articles on traffic control or traffic planning. Before the semiannual clearing out of magazines to be discarded, the most pertinent articles of interest to our engineers are cut out and preserved in a notebook.



Nancy Strong, Library Assistant, and William Kraisosky, newly appointed junior civil engineer from Walla Walla College in Washington, consult reference material in the District VIII library.

Typical requests of employees using the library are: a specifications writer who needs information from the ASTM Standards; a construction engineer who works with landscaping and needs information on California weeds and ornamentals; a research analyst who needs information from old biennial reports; a senior engineer looking for an article in an old volume of ASCE Transactions or Highway Research Board Proceedings; a traffic engineer who needs to see an ENO reprint or an old ITTE Street and Highway Proceedings; an engineering aid studying for the highway technician exam checks out a Construction Manual or a Planning Manual; a newly hired aid I checks out a surveying text; a man studying for the EIT borrows a book on strength of materials; a right-of-way man comes in to look up the meaning of terminology used on an old Spanish land grant or a legal matter; a steno reads a pamphlet on letter writing; an engineer preparing for the RE exam borrows one of the books that can be taken to the exam; a delineator refers to old issues of our "Profiles" or the news organ from some other district; some spend their "break" periods in the library.

Much of the material available in the library is supplied by the State, such as publications of the Highway Research Board and others. Some material is donated by the publisher. In order to obtain needed study material not available through either of these sources, some employees organized a Highway Engineers' Club, with dues

SEVEN PROMOTED BY DIVISION OF ARCHITECTURE

The State Division of Architecture has announced the promotion of seven of its employees to fill vacancies and to further the division's rotation plan.

Clarence T. Troop, formerly Area III construction supervisor, has been appointed chief construction supervisor for the division, a new position responsible for the manning, staffing, administration and co-ordination of construction service for the division.



CLARENCE T. TROOP

Merle A. Ewing, schoolhouse structural engineer for Area II, has been appointed chief structural engineer (schoolhouse), a new position in charge of the division's schoolhouse section which checks and passes on the safety aspects of private architects' plans for public school buildings erected throughout the State. He will also continue to direct Area II's schoolhouse activities in north central California.



MERLE E. EWING

Responsiblity for the functions of both the new positions had been under C. M. Herd, chief construction engineer for the division. However, following Herd's retirement on April 30, a reorganization plan was put into effect abolishing the chief engineering post and splitting it into two positions.



N. G. GATOURA

Taking over Troop's Area III construction supervisory duties in Los Angeles is N. G. Gatoura, district construction supervisor, districts 1 and 2, Napa.

Lawrence L. Dushkin, construction supervisor at Pacific State Hospital, district 5, moves north to take Gatoura's place.



RICHARD T. CASEY

The division also appointed Richard T. Casey, general construction supervisor six years, Sacramento, as construction supervisor in charge of Area I with headquarters in the Oakland State Office Building.

He succeeds Thomas M. Curran, 12-year holder of the job, who retired April 1. Construction Area I comprises the coastal and bordering counties from Monterey to the Oregon line.



SIDNEY PAULE

To fill Casey's general supervisory post, Sidney Paule, supervisor of construction district 5, Los Angeles County, has been shifted to the Sacramento headquarters.

Charles Blackburn, a construction supervisor at the Pomona campus of California State Polytechnic College, has been promoted to supervisor of district 5, succeeding Paule. His headquarters will be in the Los Angeles State Office Building.

LIBRARY

Continued from page 68 . . .

of one dollar annually. The club has supplied the library books which can be taken to the RE examination, other useful study material, and also library book covers. Books have also been donated by persons who have retired.

The convenience of having all books and pamphlets collected in a library saves time for employees needing to use the material. This compensates for the time spent by the employee classifying and cataloguing the books and pamphlets, keeping the shelves in order, checking the books in and out, and aiding employees in finding what they need.

Stanley Retires From City-County

J. N. Stanley, senior highway engineer in the City and County Projects Section of the State Division of Highways, retired on June 30. He had been with the division 34 years.

A native Californian, Stanley was born at Carrville, Trinity County, and attended grade and high school in Magalia and Oroville, Butte County.



J. N. STANLEY

He served with the 21st Infantry, U.S. Army, from 1918 to 1921 and received an appointment to the U.S. Military Academy at West Point.

He resigned from the Academy in 1922 and for the next seven years did engineering work for private lumber companies, the Idaho Highway Department and the Butte County Road Department.

He joined the California Division of Highways in 1929 and spent most of the next 17 years in District IX as inspector, designer and resident engineer on highway projects.

These included location of the Lone Pine-Death Valley Road through the Argus, Panamint and Funeral Ranges, resident engineer on the Conway Summit (U.S. 395) and Tioga Pass (State Sign Route 120) routes, and location of defense access roads in eastern California during World War II. Stanley also handled much of the preliminary work which resulted in the adoption and construction of the present highway over Monitor Pass in Alpine and Mono Counties.

In 1946 he transferred to District III in Marysville.

He was appointed assistant engineer of federal secondary roads at headquarters office in Sacramento in 1951 and put in charge of urban extension projects when the Division's city and county road sections were reorganized in 1962.

Stanley is a Mason and a member of the Elks Lodge.

Retirement Claims 26 More Employees

Headquarters Office

Victor L. Chertorisky, Associate Highway Engineer, 34 years; * Norman H. Heggie, Assistant Purchasing Specification Analyst, 35 years; George N. Webb, Principal Highway Engineer, 35 years.

Bridge Department

Floramay Hageman, Intermediate Account Clerk, 21 years.

District I

* Marie M. Clark, Intermediate Account Clerk, 8 years; Frank Faulkner, Highway Field Office Assistant, 30 years.

District II

James T. Smallen, Highway Mantenance Man II, 37 years.

District III

John Q. Adams, Highway Maintenance Man II, 29 years; Alvin E. Engraham, Highway Foreman, 32 years.

District IV

Leonard Campos, Groundsman, 3 years; Donald C. Milner, Associate Highway Engineer, 32 years.

District V

Silvio D. Binsacca, Highway Maintenance Man II, 31 years; Seldon N. Isham, Assistant Highway Engineer, 35 years.

District VII

Richard O. Berlin, Highway Maintenance Man II, 6 years; * Hazel M. Greeley, Delineator, 7 years; Mode E. Killingsworth, Highway Mantenance Man II, 31 years; Howard D. May, Highway Maintenance Man III, 30 years; Charles J. McCullough, Associate Highway Engineer, 26 years; Walter J. Sherman, Groundsman, 8 years; Thomas G. Sibley, Associate Right of Way Agent, 24 years; * Mildred S. Whiteley, Intermediate Account Clerk, 6 years.

District VIII

Herbert G. Gaffko, Reproduction Machine Operator, 7 years; Violet M. Tinker, Highway Field Office Assistant, 12 years.

* Disability.

District IX

John R. Daughdrill, Highway Maintenance Man I, 10 years.

District XI

Joe Minter, Highway Maintenance Man I, 11 years.

Shop 7

James F. Perkins, Automobile Mechanic, 14 years.

Big Bear Road Dated By Reader as 1923

The Editor
California Highways and Public Works
Sacramento, California

DEAR SIR:

The January-February 1963 issue of your publication contained an article entitled "Big Bear Road" which described the widening of a section of this road to four lanes. The statement was made that the road was constructed in 1926.

The road was first constructed in 1922-23 by the Bureau of Public Roads with forest highway funds under a contract awarded to the Utah Construction Company. This contract, which extended from a junction with the Green Valley road on the west to Big Bear Lake dam on the east, provided for grading only. Mr. J. H. Obermuller, who later accepted employment with the California Division of Highways, was project engineer. I was a member of the construction engineering crew and during the two-year period the work was in progress became intimately acquainted with the portion you now refer to as the "Arctic Circle Section."

With the completion of the project in the fall of 1923 direct approach to Big Bear Lake from the west became possible without negotiating the tortuous "Snowslide Grade."

Yours very truly,

ERIC E. ERHART
5038 5th Street N.
Arlington, Virginia

Ernest H. Sagehorn Retires on July 25

Ernest H. Sagehorn, associate bridge engineer for the California Division of Highways, will retire on July 25 after 30 years of state service.

His engineering career, beginning with his graduation from the University of California in 1927, has included varied roles in the planning, construction and maintenance of bridges.

He has also carried out specialized studies of precipitation and stream hydraulics in connection with bridge design. His chart of precipitation characteristics has become a basic reference in the planning of stream crossings throughout California.

For seven years before and during World War II Sagehorn served in the Civil Engineer Corps of the U.S. Navy, including duty in the South Pacific. He retired recently with the rank of commander.

Sagehorn has served on the board of directors of the Fair Oaks Recreation and Park District for the past three years.

SAN CLEMENTE

Continued from page 31 . . .

Highway business, which fell off when the freeway was completed, has been regained on a sounder basis.

Long-range city planning is proceeding with the assurance that lines of transportation are permanently defined.

More residents of nearby communities—San Juan Capistrano, Capistrano Beach and Dana Point—now come to San Clemente to shop.

Many people who work in Santa Ana, Costa Mesa, Anaheim and other areas of Orange County are acquiring homes in San Clemente because of the temperate climate and fast freeway transportation.

Landscaping of the freeway blends into the natural beauty of the area, and its signs carrying the Spanish place names emphasize the early California atmosphere so characteristic of the community.

San Clemente's chosen way of life is being preserved.

LEONARD HOLLISTER RETIRES; R. J. IVY APPOINTED

The retirement of Leonard C. Hollister, bridge engineer in charge of special projects for the California Division of Highways, and the promotion of Raymond J. Ivy to succeed him have been announced by State Highway Engineer J. C. Womack.

Hollister's responsibilities in the past eight years have included design and construction work on major toll bridges, including the parallel Carquinez Bridge, the Benicia-Martinez Bridge and the Vincent Thomas (San Pedro-Terminal Island) Bridge. He has also co-ordinated studies to date for the proposed San Diego-Coronado crossing.



LEONARD HOLLISTER

His total state service has covered 36 years, all of it with the Division of Highways Bridge Department.

Hollister was born in Pittsburgh, Pennsylvania, attended school in Sheridan, Wyoming, and was graduated with a B.S. in civil engineering from the University of Cincinnati in 1922 after serving in World War I. He engaged in bridge design work in Philadelphia, and came to California and the Division of Highways in 1927 as a junior bridge engineer.

He was in charge of bridge design units working on freeway and stream crossing structures throughout the state, including the Pasadena Freeway and the Four-Level Interchange in Los Angeles, the Sacramento River Tower Bridge and the first units of the elevated freeway through San Francisco connecting with the San Francisco-Oakland Bay Bridge.

The San Francisco project represented the first all-welded steel viaduct in the state. Other developments with which Hollister was identified in their earliest stages include the use of curved box girders and prestressed concrete girders; and the introduction of new lightweight alloy steel, employed on the Carquinez project.

He was promoted to principal bridge engineer and placed in charge of special projects, beginning with the Carquinez structure, in 1955. That job was completed in November, 1958, and was followed by the Benicia-Martinez Bridge which was opened to traffic in September, 1962. The Vincent Thomas Bridge, the first suspension bridge in Southern California, will be dedicated on September 28, 1963.

Hollister is a member of the American Society of Civil Engineers, the American Concrete Institute, and the Structural Engineers Association of California. He is the author of numerous engineering articles in professional publications and of a course for engineers on the moment distribution method of stress analysis.

Hollister and his wife Monica have a daughter, Mrs. Dorothy Jean Norris, of Milton, Florida.

Ivy, his successor in charge of special bridge projects, effective August 1, has been with the Bridge Department since his graduation from the University of California with a B.S. in civil engineering in 1931.

Ivy was born in Morgan County, Missouri, came to California as a child, and was educated in Stockton.

His first eight years with the Division of Highways were spent in bridge construction work in various parts of the state. Later he was engaged in bridge design, including the plans for the Terminal Island lift span bridge built for the U.S. Navy in World War II and some of the structures on the Nimitz Freeway in Oakland.



RAYMOND J. IVY

He also took part in the feasibility studies leading up to the State's taking over the San Mateo-Hayward and Dumbarton toll bridges in 1951.

Ivy served as a Navy officer in the Civil Engineer Corps in World War II, engaging in construction of airfields, hospitals and bases in the South Pacific; and in the Korean War, serving in Alaska and the Philippines.

When he returned to the Division of Highways in 1953, he was placed in charge of bridge maintenance. His responsibilities in this post included the inspection of the structural condition of all highway and stream crossings on the state highway system, currently numbering nearly 7,000.

Earlier this year Ivy was transferred to the position of bridge construction engineer for Northern California, from which assignment he moves up to his new duties.

Ivy is a member of the American Society of Civil Engineers and the University Club of Sacramento. He and his wife Caryl have a son, Frank, currently serving in the Navy.

Elbert C. Brown

Elbert C. Brown, 76, retired district engineer for the U.S. Bureau of Public Roads in California, died in Sacramento on June 26 after a long illness.

Brown retired in 1957 after 48 years of service with the government, 38 of them with the bureau.

Born near Clifton Hill, Missouri, Brown was a graduate of Missouri State University. He was chief bureau engineer in the State of Nevada for 14 years before opening the Sacramento office of the bureau in 1945.

His career began with work on the Shoshone Dam near Cody, Wyoming, in 1909. He spent seven years in the Philippine Islands building roads for the War Department. He was a captain in the Army Engineers during World War I.

Brown was a lifetime member of the American Society of Civil Engineers and Phi Kappa Psi and Tau Beta Pi fraternities.

He is survived by his wife, two sons and a daughter.

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

HIGHWAY TRANSPORTATION AGENCY

ROBERT B. BRADFORD . . . Administrator

DEPARTMENT OF PUBLIC WORKS . . . JOHN ERRECA, Director

FRANK A. CHAMBERS . . . . Chief Deputy Director

RUSSELL J. COONEY . . Deputy Director (Management)
HARRY D. FREEMAN . . Deputy Director (Planning)

T. F. BAGSHAW . . . . . Assistant Director
JOHN H. STANFORD . . . . . Assistant Director

JUSTIN DuCRAY . Departmental Management Analyst
S. ALAN WHITE . . Departmental Personnel Officer

DIVISION OF HIGHWAYS

J. C. WOMACK . . . State Highway Engineer, Chief of Division

CHAS. E. WAITE . . . Deputy State Highway Engineer
J. P. MURPHY . . . Deputy State Highway Engineer
J. A. LEGARRA . . Deputy State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
GEO. LANGSNER . . Assistant State Highway Engineer
FRANK E. BAXTER . Assistant State Highway Engineer
J. C. BURRILL . . . . . Comptroller
JOHN L. BEATON . . . . . Equipment Engineer
C. G. BEER . . . . . Urban Planner
GEORGE A. HILL . . . . . Traffic Engineer
F. N. HVEEM . . . Materials and Research Engineer
J. F. JORGENSEN . . . . . Construction Engineer
SCOTT H. LATHROP . Personnel and Public Information
C. T. LEDDEN . . City and County Projects Engineer
H. C. McCARTY . . . . . Office Engineer
DANA G. PENGILLY . . . . Planning Engineer
E. J. L. PETERSON . . Program and Budget Engineer
R. V. POTTER . . . . Systems Research Engineer
E. L. TINNEY . . . . . Maintenance Engineer
W. L. WARREN . . . . . Engineer of Design
A. L. ELLIOTT . . . . Bridge Engineer—Planning
L. C. HOLLISTER . Bridge Engineer—Special Projects
I. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area

Right-of-Way

RUDOLF HESS . . . . . Chief Right-of-Way Agent
DEXTER D. MacBRIDE . . . . . Assistant Chief
RAY E. O'BIER . . . . . Assistant Chief
R. S. J. PIANEZZI . . . . . Assistant Chief
JACQUES T. ZEEMAN . . . . . Assistant Chief

District I, Eureka

SAM HELWER . . . . . District Engineer

District II, Redding

H. S. MILES . . . . . District Engineer

District III, Marysville

ALAN S. HART . . Assistant State Highway Engineer

District IV, San Francisco

J. P. SINCLAIR . . Assistant State Highway Engineer
R. A. HAYLER . . . . . District Engineer
HAIG AYANIAN . . . . . District Engineer
C. F. GREENE . . . . . District Engineer

District V, San Luis Obispo

E. R. FOLEY . . . . . District Engineer

District VI, Fresno

W. L. WELCH . . . . . District Engineer

District VII, Los Angeles

E. T. TELFORD . . . Metropolitan District Engineer
A. L. HIMELHOCH . . . . . District Engineer
A. C. BIRNIE . . . . . District Engineer
A. W. HOY . . . . . District Engineer
R. E. DEFFEBACH . . . . . District Engineer

CALIFORNIA HIGHWAY COMMISSION

JOHN ERRECA . . . . Chairman and Director of Public Works
JAMES A. GUTHRIE . . Vice Chairman San Bernardino
ARTHUR T. LUDDY . . . Sacramento
ROGER S. WOOLLEY . . . San Diego
ABRAHAM KOFMAN . . . San Jose
FRANKLIN S. PAYNE . . Los Angeles
WILLIAM S. WHITEHURST . . . Fresno
JACK COOPER, Secretary . . . Sacramento

District VIII, San Bernardino

C. V. KANE . . . . . District Engineer

District IX, Bishop

C. A. SHERVINGTON . . . . . District Engineer

District X, Stockton

JOHN G. MEYER . . . . . District Engineer

District XI, San Diego

JACOB DEKEMA . . Assistant State Highway Engineer

State-owned Toll Bridges

CHARLES L. SWEET . . . . . Bridge Engineer

DIVISION OF CONTRACTS AND RIGHTS-OF-WAY (LEGAL)

HARRY S. FENTON . . . . . Acting Chief Counsel

HARRY S. FENTON . . . Assistant Chief (Sacramento)
HOLLOWAY JONES . . Assistant Chief (San Francisco)
GEORGE C. HADLEY . . Assistant Chief (Los Angeles)

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

NORMAN C. RAAB . . . . Chief of Division
BEN BALALA . . . . . Principal Bridge Engineer

DIVISION OF ARCHITECTURE

CARL C. McELVY . . . . . State Architect, Chief of Division

EARL W. HAMPTON . . . . . Deputy Chief, Architecture and Engineering
HUBERT S. HUNTER . . . . . Deputy Chief, Administrative
MERLE A. EWING . . . . . Chief Structural Engineer (Schools)
ARTHUR F. DUDMAN . . . . . Assistant State Architect (North)
TOM MERET . . . . . Assistant State Architect (South)
CLARENCE T. TROOP . . . . . Chief Construction Supervisor

DIVISION OF AERONAUTICS

CLYDE P. BARNETT . . . . . Director, Chief of Division

90344 7-63 53,200

printed in CALIFORNIA STATE PRINTING OFFICE

Design and Materials Conference



The use of various items of drilling equipment was explained by Gifford Stafford, at right, to design and materials engineers from California counties in the course of a two-day meeting at the Division of Highways Materials and Research laboratory in Sacramento

Design and materials engineers from 26 California counties participated in two days of technical discussions and demonstrations at the Division of Highways Materials and Research Department laboratory in Sacramento May 23-24.

A total of 57 engineers were in attendance at the meeting, which was arranged at the request of the County Engineers Association.

The discussions covered various aspects of materials testing, including sampling and testing of aggregates, compaction tests, tests on asphalts, asphalt and concrete surfaces, base materials, and the inspection and release of materials at fabrication plants. Tours through the laboratory were conducted to illustrate the use of different types of testing equipment.

Materials and Research Engineer Francis N. Hveem of the Division of Highways moderated the discussions. Special presentations were made by Robert Latchaw, Contra Costa County construction engineer, on the traffic index for low volume roads; Joe Vicelja, materials engineer of Los Angeles County, on reflection cracking through asphalt concrete pavement; and William Garrison, Contra Costa County materials engineer, on lime-treated base materials.

Garrison and George Sherman of the Division of Highways were in charge of arrangements for the meeting.

California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

RETURN REQUESTED

SEATTLE PUBLIC LIBRARY
4TH & MADISON
SEATTLE 4, WASHINGTON

R56

BULK RATE
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152



Seattle Public Library
NOV 13 1963
FILE IN STACKS
TECHNOLOGY

CALIFORNIA Highways and Public Works



SEPTEMBER–OCTOBER
1963

State Reorganization Changes Department, Commission

The 1963 Legislature made several changes in organization which affect the state highway program. Generally, they are further steps which implement Governor Brown's executive reorganization program and carry forward the activation of the Highway Transportation Agency.

The two most important changes are (1) Division of Architecture leaves the Department of Public Works, and (2) the Highway Transportation Agency Administrator becomes chairman of the California Highway Commission and a member of the California Toll Bridge Authority.

A Department of General Services comes into existence on October 1, 1963 (A.B. 2006, Marks and Knox, coauthors: Senators Miller and Sturgeon). As long studied and often recommended, the department will be responsible for central business management functions and other central services for the operation of state government. While most of these services are transferred from the Department of Finance, the Division of Architecture, which is the central design and construction service for state government, will move from the Department of Public Works to the new department. The Department of Finance retains its central fiscal and management planning responsibilities.

All employees of the Division of Architecture are automatically transferred to the new department on October 1, with no change in status.

In another important area, the Legislature and the Governor moved to strengthen the Highway Transportation Agency, which had been created in 1961 as a major element in the executive reorganization program. In S.B. 1019 (Collier) the following changes were made, effective September 21, 1963:

(1) The Administrator of the Highway Transportation Agency becomes ex officio member and chairman of the California Highway Commission in place of the Director of Public Works.

The Director of Public Works now becomes the administrative officer to the California Highway Commission.

(2) Similarly, the Administrator replaces the Director of Public Works as a member of the California Toll Bridge Authority, and the director becomes administrative officer to the authority.

(3) The Division of Contracts and Rights-of-way and the Division of Bay Toll Crossings are established by statute as major components of the department, in addition to the Division of Highways, which had already been created by law. Until now, the Divisions of Contracts and Rights-of-way and Bay Toll Crossings had been created by administrative order of the director.

The Director of Public Works, however, still organizes the work of the Department, assigns functions and responsibilities to the divisions, and has the authority to create additional divisions by administrative action, with the approval of the Governor, if they should be required.

(4) There is a slight change in the name of one division: the Division of San Francisco Bay Toll Crossings becomes the Division of Bay Toll Crossings.

(5) The appointments of the Director of Public Works and the Administrator of the Highway Transportation Agency are made subject to confirmation by the Senate.

(6) The Administrator of the Highway Transportation Agency is given the authority to exercise any power or jurisdiction, or to assume or discharge any responsibility, or to carry out or effect any of the purposes vested by law in any department in the agency. The three departments which make up the Highway Transportation Agency are the Departments of Public Works, California Highway Patrol, and Motor Vehicles.

(Editor's note: For report on other 1963 legislative actions affecting the Division of Highways, see page 12.)

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

Vol. 42 September-October Nos. 9-10



FRONT COVER: Division of Highways Employee Clifford Ahnlund, District VIII, demonstrates correct flagging procedure for controlling traffic when road is obstructed by equipment. Skip loader is picking up debris from slide on Rim of the World Highway near Big Bear Lake, San Bernardino County. Photograph by Lyman Rich, Claims Investigator, District VIII. See story on page 32.

BACK COVER: Artist's painting of new Cold Springs Canyon Bridge on State Sign Route 150, Santa Barbara County. See story on page 14 this issue. Painting by William Tuthill, Bridge Architecture Section, Headquarters.



CONTENTS

	Page
State Reorganization Changes Department	Inside front
Collier Tunnel By Frederick Graebe, Associate Bridge Engineer and Richard C. Warner, Associate Highway Engineer	2
U.S. 99—Bakersfield By J. E. Roberts, M. F. Silva and N. L. Lambeth, Resident Engineers	7
New Legislation	12
Cold Spring Canyon Arch By F. H. Yoshino, Resident Engineer and R. L. Whitaker, Project Designer	14
Top 10 Percent By Rudolf Hess, Chief Right-of-way Agent	21
Nondiscrimination Policy Reiterated	26
Westside Progress By M. E. Cornelius, Assistant Engineer of Design	27
Employee Safety By B. A. Switzer, Division Safety Engineer	32
John Stanford Named to New Department	38
Modesto Project By J. G. Meyer, District Engineer	39
Fenton is Legal Head, Rhyner Named Deputy	42
Modernized Counters By C. F. Wasser, Jr., Assistant District Traffic Engineer and Carroll E. Dunham, Associate Highway Engineer	43
Personnel	46
Beaton is New Lab Head; Andersen Promoted	48
Route Adoptions	49
J. C. Womack Is Named Among Public Works "Top Ten"	50
Living Pavements By D. L. Spellman, Supervising Materials and Research Engineer	51
Japan's Highways	55
West Placerville Freeway By Frank V. Rakela, Associate Highway Engineer	58
Toll Bridge Authority Re-funds Two Bond Issues	61
Traffic Safety Conference	Inside back

Retirements

Departmental List	38	Francis N. Hveem	47
Tom Bigelow	63	Helen Klauser	13
Earl Hampton	62	C. E. Waite	46
Edgar R. Hoffman	31	J. T. Zeeman	63

Obituaries

In Memoriam	62	R. C. Richardson	62
Mervyn R. Blacow	62		

LESTER S. KORITZ, *Editor*

STEWART MITCHELL, *Associate Editor* JOHN C. ROBINSON, *Associate Editor*

WILLIAM R. CHANEY, *Chief Photographer*

Editors are invited to use information contained herein and to request prints of any black and white photographs.

Address communications to: EDITOR,

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

P.O. Box 1499

SACRAMENTO, CALIFORNIA

Collier Tunnel

New Project on U.S. 199 Is Officially Dedicated

By FREDERICK GRAEBE, Associate Bridge Engineer and
RICHARD C. WARNER, Associate Highway Engineer



The Randolph Collier Tunnel and approaches, located two miles south of the California-Oregon border on U.S. 199, was dedicated and opened to traffic on July 20, 1963, after nearly 3½ years of construction. The dedication ceremonies, which were attended by dignitaries from California, Oregon and Nevada, honored veteran State Senator Randolph Collier, who represents Del Norte and Siskiyou Counties and is nationally known as a leader in highway legislation. United States Senator Clair Engle unveiled the dedication plaque and aided Senator Collier in the ribbon cutting ceremony.

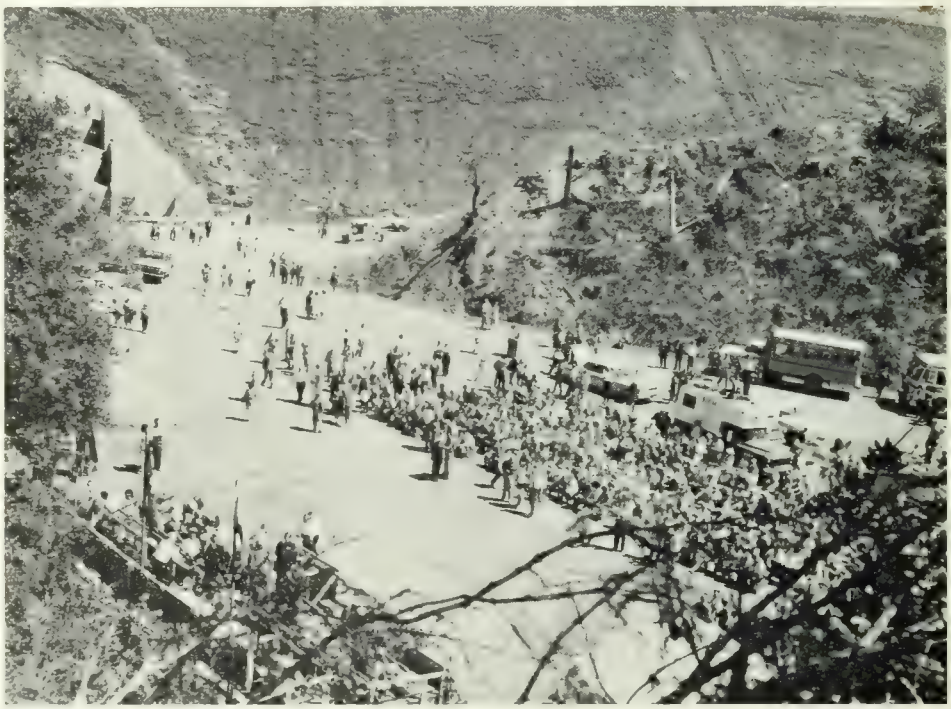
The tunnel project, with its approaches, was completed at a cost of nearly $7,500,000, in four separate contracts.

The initial contract provided for grading of the north approach; this work was accomplished by the Gibbons and Reed Construction Company at a cost of $446,000. A second contract, awarded to Morrison-Knudsen for $2,440,000 covered construction of the south approach as well as surfacing of the north approach. The tunnel portion of the project was built by the Grafe-Callahan Construction Company at a cost of $4,350,000. The fourth and final contract was awarded to Meyers Industrial Electric Company for installation of tunnel lighting and ventilating equipment—total cost $150,000.

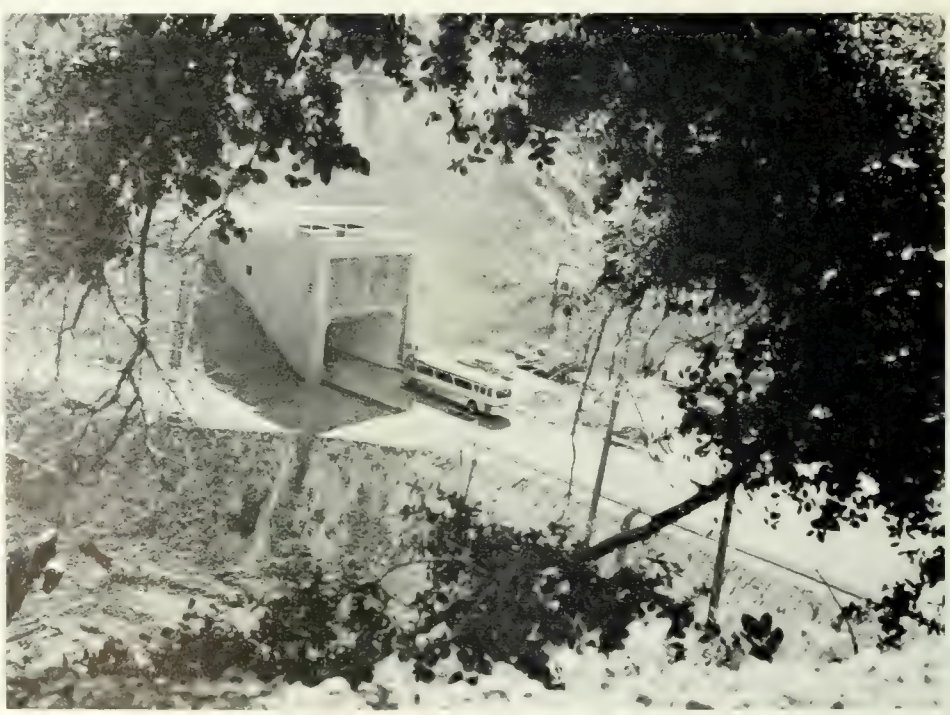
Freeway Standards

The completed project has a total length of 4.3 miles of modern two-lane highway constructed to freeway standards of grade and alignment. It

(EDITOR'S NOTE: Previous articles on this project were published in the September-October 1960 and May-June 1961 issues.)



Dedication of the tunnel on July 20 drew hundreds of people and many dignitaries from California, Oregon and Nevada to honor veteran State Senator Randolph Collier in ceremonies near the south portal.



Traffic began to use the new tunnel immediately after its dedication. Here a bus enters the north portal. Note the covered ventilation structure on top of the portal.

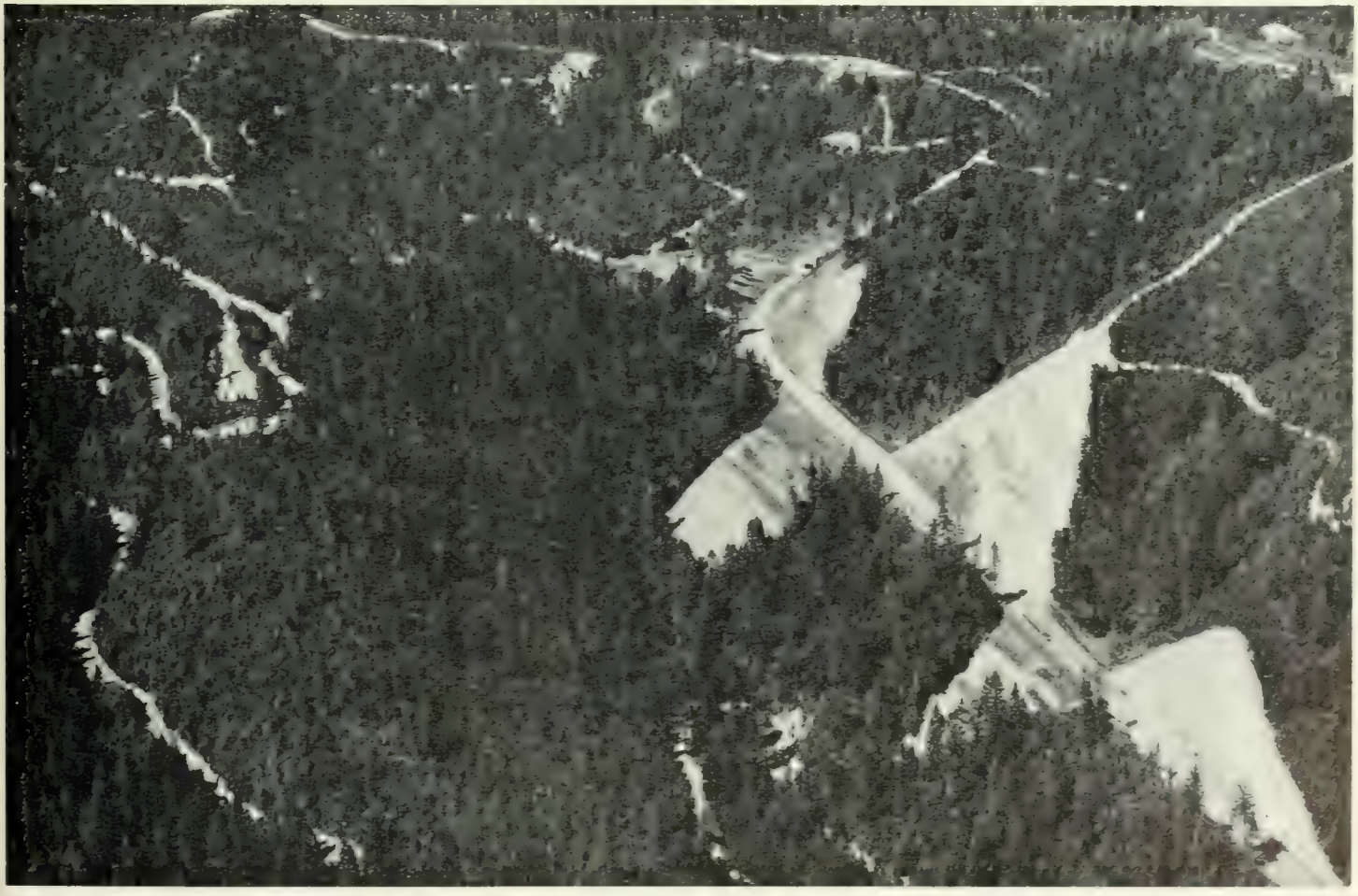
replaces more than seven miles of narrow, twisting mountain road which formerly snaked its way over the Hazelview Summit of Oregon Mountain. On the old road over the summit a motorist was required to negotiate five steep switchbacks and make a total of 144 turns, many of which were posted for speeds of 25 mph and less.

As a contrast, the new road has been designed for 60-mph speeds and has but 16 curves. In addition, the new highway is some 350 feet lower in elevation at its highest point—a factor which materially reduces the snow removal problem during the winter months.

The key to the appreciable saving in distance and time which the new project affords is the Randolph Collier Tunnel. This structure has a portal-to-portal length of 1,835 feet and provides two 13-foot traffic lanes and two 2'6"-wide safety curbs.



A northward view of heavy grading operations last year near the south tunnel approach.



An aerial of the project looking toward the south portal of the tunnel. The old highway (left) winds through the Oregon Mountain forest and Hazelview Summit



A welder attaches a brace to a steel support of the east footing drift.

Began at North Portal

Tunnel construction began at the north portal, where the contractor first excavated two parallel footing drifts, each with a horseshoe-shaped cross section about 15 feet high and 15 feet wide at the base. Excavation for these two drifts was accomplished by the shield method. Fitted with a cutting edge in the front, the shield was forced into the mountain by six 45-ton jacks mounted at the rear of the shield. Arch-shaped steel drift supports were placed under protection of the shield and were blocked and lagged with timbers to support the excavated tunnel bore. After both drifts had been excavated some 600 feet into the mountain, the footing sections of the permanent arch lining were constructed.

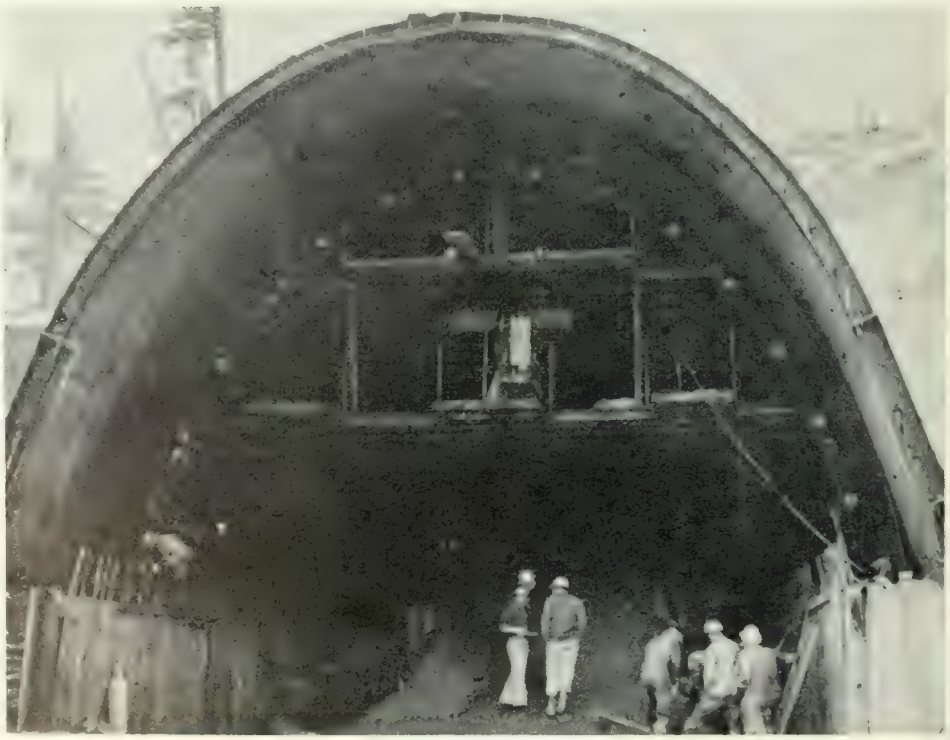
After completion of the arch footings, a second larger shield was used to complete excavation of the north portal heading. Skidding on rails cast into the concrete footing walls, the top heading shield was forced into the mountain by a battery of 20 jacks capable of a maximum jacking force in excess of 1,000 tons. Excavation and support of the top heading followed the same pattern—except on a larger scale—as established during the footing drift operation. Top heading shield mining was discontinued when the end of the arch footings was reached—600 feet in from the north portal.

Larger Bore Used

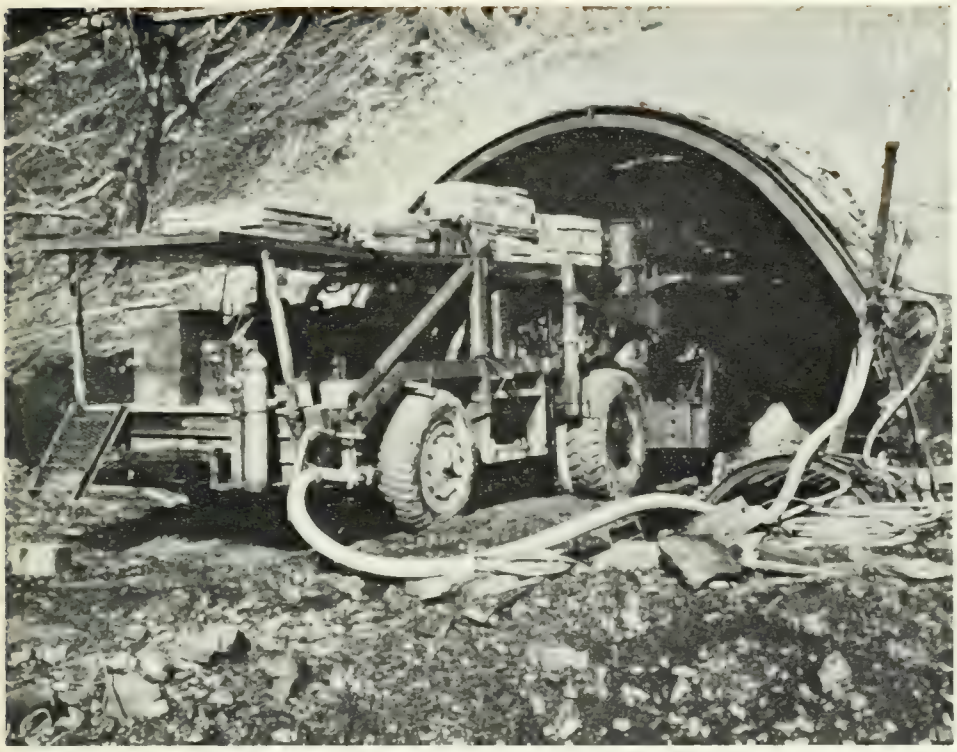
Simultaneously with the north portal excavation, the remaining 1,200 feet of tunnel were driven from the south portal. More favorable rock conditions at the south portal allowed the contractor to proceed initially with the excavation of a much larger bore.

The first excavation phase consisted of an arch-shaped top heading 15 feet high and 30 feet wide at the base. Two subsequent bench excavation operations lowered the floor of the initial heading 7 feet and 10 feet, respectively, until the full size of the bore was excavated. As the steel supports were undermined by the successive bench operations, additional support posts were installed as underpinning to transfer the rock load to the new heading floor.

As the various excavation stages permitted, portions of the concrete arch lining were constructed. As mentioned above, arch footings were constructed in the north footing drifts after completion of drift excavation. After completion of the north bore top heading excavation, the remaining concrete lining above the footings was poured in 25-foot sections, beginning



The north portal top heading shield, supported upon footing wells, enters into the mountain beyond.



The excavation jumbo enters the bore at the south portal top heading excavation area.

600 feet underground and proceeding toward the north.

In the south heading 25 100-foot sections of arch footing were constructed in sequence with the bottom bench excavation. The remainder of the arch lining was completed in 50-foot sections beginning at the south portal and proceeding toward the center of the tunnel.

Regulated Electroliers

The tunnel is continuously illuminated by electroliers regulated by outside photoelectric cells. Tunnel lighting is aided by a luminous epoxy paint on the walls and ceiling.

In addition to the tunnel, the completed project required the construction of over four miles of new highway. Grading was perhaps the most challenging feature of the road contracts, particularly at the south approach where the new alignment traverses extremely rugged terrain within the Six Rivers National Forest. This section of highway required the excavation of more than 2,400,000 cubic yards of earth and rock, with more than 600,000 cubic yards being excavated from the cut adjacent to the south tunnel portal. This cut is 438 feet in depth, and there are more than a dozen other cuts on the south approach which exceed 100 feet in depth. Fill construction was equally impressive, there being 10 fills exceeding 100 feet in height with the highest over 250 feet.

Grading work was preceded by staking and clearing, which presented many problems and hard work. The rugged terrain traversed by the south approach is cut with many small streams in deep side canyons, all covered with a heavy growth of medium-size Douglas fir trees and thick brush. Heavy rain during February and March 1961 hampered staking progress. During one 30-day period, the survey crews worked in continuous rain. Ninety to 100 inches of rain normally fall in this area in one season.

Forest Beauty Preserved

To preserve the beauty of the national forest, access to the work area was limited to within the slope limits of the job and to four access points granted by the Forest Service. During some of the early grading stages, the only means of getting to the work areas was walking or by tractors. Fuel was brought into the equipment area on a special trailer towed by a tractor. After some of the fills had been partially completed, a road suitable for four-wheel-drive vehicles was con-



South portal top heading excavation—a bench jumbo drills vertical holes preparatory to lowering the floor of the initial excavation.



Correcting the arch lining—a pump and pipelines, carrying concrete under pressure, places concrete between the form (background) and the excavated rock surface.



Grading and backfilling over the tunnel at the north portal.

structed and opened at intervals during the day.

Almost all the excavated material was moved by a fleet of nine all-wheel drive scrapers. This type of scraper unit was very effective on this job because of the exceedingly steep roads required to get from bottom of fills to top of cuts. Many of these roads had 50 percent grades. These machines were able to get on the cuts and start excavation with a minimum of pioneering.

The new roadway has a basic all-paved width of 32 feet, with an added 12-foot passing lane on steep grades. The total length of passing lanes is 2.5 miles. The roadway is paved with three inches of asphalt concrete on eight inches of plant-mixed cement treated base.

All contracts were administered by the California Division of Highways. Representing the division as resident engineer were:

Fred Smith—Grading north approach

George A. Jochim—Tunnel contract; lighting and ventilation contract

Richard C. Warner—Grading south approach and surfacing contract.

Toll Bridge Opens To Traffic Nov. 15

The new $21,000,000 Vincent Thomas Bridge, Southern California's first major suspension span, was scheduled for opening to traffic at 12.01 a.m. on November 15, 1963.

Dedication ceremonies for the new four-lane crossing from San Pedro to Terminal Island were held on September 28, in connection with the annual Fishermen's Fiesta.

The toll for privately owned passenger vehicles will be 25 cents. The ferry *Islander,* which has been operated by the Los Angeles Harbor Department, will be superseded by the new bridge.

Associate Bridge Engineer Richard L. Hathaway has been assigned as manager of the structure.

Total length of the bridge is 6,060 feet, with a clearance above the harbor channel of 185 feet. The central suspension span is 1,500 feet long.

U.S. 99-Bakersfield

Completion Marks 10 Years of Planning, Construction

By J. E. ROBERTS, M. F. SILVA and N. L. LAMBETH, Resident Engineers

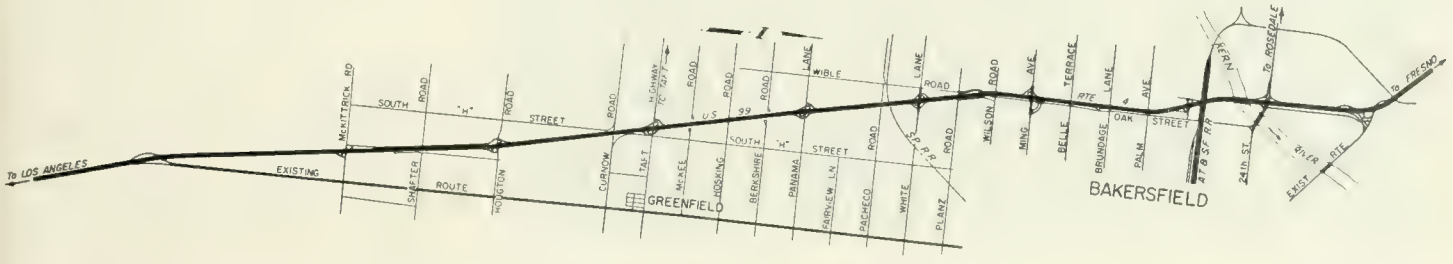


On July 23, 1963, 10 years of planning, right-of-way acquisition, and construction were culminated with the dedication and opening of the West Bakersfield Freeway. Henceforth, the north-south traveler on U.S. 99 between Fresno and Los Angeles will be able to bypass the City of Bakersfield and avoid the congestion on the old route over Union Avenue, Golden State Highway and the much publicized Garces Circle. Moreover, the route provides signal-free motoring between the City of Kingsburg and Castaic Junction, a distance of some 155 miles.

The freeway, which extends between approximately 13 miles south and 1 mile north of the City of Bakersfield, is 18½ miles in length over completely new alignment. It provides a four-lane divided facility through the rural section of its course and six lanes in the urban area where higher traffic volume dictated the need for additional capacity. Included in its length are 10 complete interchanges, 10 separations, 1 river crossing, 1 railroad underpass and 2 railroad overheads, all of which required the building of 43 structures at 27 locations and the widening of 2 existing ones. Three years in building, the fa-



Northerly view of the West Bakersfield Freeway shortly after its completion.



This map shows the routing of the new freeway through Bakersfield.



Heavy congestion on old U.S. 99 through Bakersfield prior to the opening of the freeway.



A night photo of old U.S. 99 through Bakersfield prior to the freeway opening with traffic volume indicated by the lines from oncoming headlights (left) and the fainter tracery of taillights (right).

cility was constructed at a total cost of $21,500,000, including rights-of-way.

Three Contracts

Construction was performed under three separate contracts; the first of which was awarded to Fredericksen & Kasler of Sacramento on September 17, 1960, at a cost of $7,093,320 for the southern 13.3 miles and completed on August 9, 1962. This was followed on September 1, 1960, by award of a $923,372 contract to Tumblin Company of Bakersfield for the construction of the Bakersfield Yard Overhead and the Kern River Bridge which are within the limits and would facilitate the work on the northern 5.3 miles. This contract was completed on October 26, 1961. The third contract, which would complete the freeway, was awarded to Gordon H. Ball of Danville on October 23, 1961, at a cost of $6,036,000 and completed in July, 1963.

Major items of work consisted of 3,100,000 cubic yards of roadway excavation; 1,365,000 tons of imported borrow; 730,000 tons of various base materials; 132,300 cubic yards of portland cement concrete pavement and 150,000 tons of asphalt concrete pavement.

Long Cut Section

The major portion of the roadway excavation was concentrated in one cut section, approximately three miles long at the southwest edge of Bakersfield. Some of this material was moved with scrapers but due to the length of the haul, most was moved with a portable belt loader and bottom dump trucks. The major portion of the roadway excavation consisted of cohesionless sand, which created numerous problems in making and holding grades and in the movement of hauling equipment.

The contractors overcame some of this difficulty by prewatering the cut sections with piped overhead sprinkler-type irrigation systems. A fairly high productive rate was accomplished on the movement of roadway excavation; an average of approximately 7,500 cubic yards per day.

After the slopes were finished, straw was applied to both embankment and



A view northward along the new freeway at Brundage Lane overcrossing near the Bakersfield city limits.

cut slopes in order to maintain stability in the sandy material.

Three Mixers Used

Fredericksen & Kasler placed the first 13.3 miles of PCC pavement using conventional side forms and traveling concrete mixer methods. The normal 24-foot-wide paving train uses two concrete mixers, but the contractor elected to use three dual drum mixers. By using three mixers the contractor attained a maximum production of 2,865 cubic yards in 9½ hours and an average of 1,880 cubic yards per day for the project.

On the Ball contract a relatively new concept in concrete paving was utilized. The spread consisted of a slip form paver, eighteen 7½-cubic-yard tilting-body transit mixers, and a new "low profile" portable batch plant. Paving was single pass 24-foot and 36-foot widths. This combination produced and laid as high as 4,350 cubic yards of pavement 36 feet wide in a 10-hour day.

The batch plant consists of five trailer-mounted components which can be towed by truck from jobsite to jobsite as 10-feet-wide permit loads. Height of each is within legal limits for highway transporting giving a completely mobile assembly. The plant derives its name from the fact that all components operate at ground level. As such, a very minimum of foundation work is required for a setup. Under ideal conditions operating under fully automatic control, this plant is capable of batching all ingredients for 450 to 500 cubic yards per hour.

More Mobile Operation

The use of transitmixers in lieu of onsite mixers presented no exceptional problems while resulting in a cleaner and more mobile operation on the street. No difficulty was experienced in discharging 1½-inch- to 2-inch-slump concrete with a satisfactory degree of uniformity.

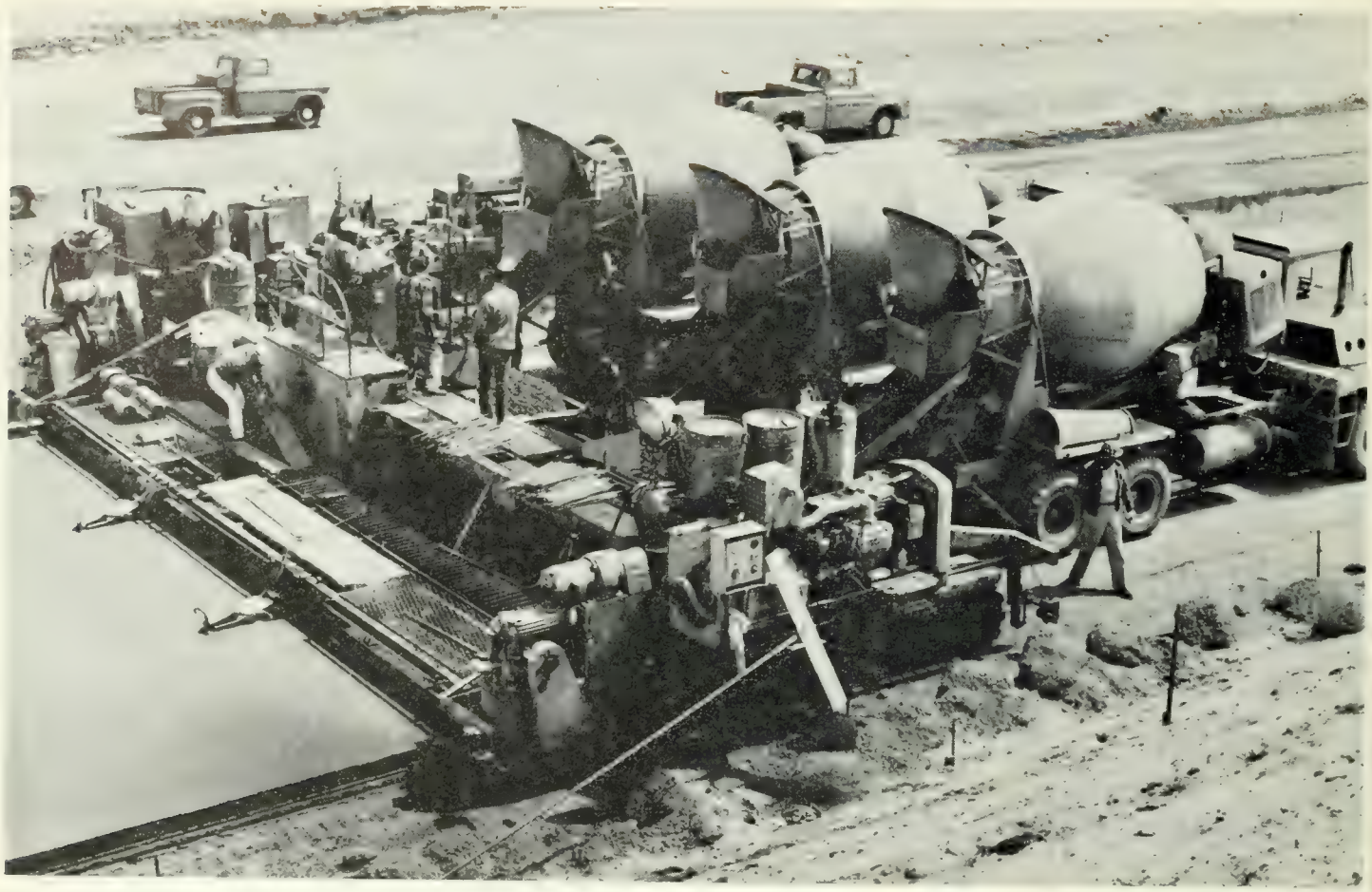
Longitudinal joints between lanes were constructed by inserting a polyethylene strip fed directly from the trailing edge of the paver. Use of this procedure in the past and during the early stages of this project sometimes resulted in a slight depression in the slab. To overcome this condition, the vibrating knife edge that fed the strip was moved ahead of the final pan float. With this change no further difficulty was experienced.

Ram-activated Arms

Another innovation was the use of a ram-activated set of parallel arms for inserting the tie bars in each of the longitudinal joints. Notches at the bot-



A northward view of the freeway crossing of the Kern River just north of Bakersfield. U S 99 also crosses over Sign Route 178 at this point.



Tilting body transit mixers feed concrete to slip form paver for a 36-foot section.



The new low profile portable batch plant is capable of batching all ingredients for 450 to 500 cubic yards per hour.



A northward view of the new freeway about 13 miles south of Bakersfield. Old U.S. 99 angles off to the right.

tom ends of the arms hold the tie bars in place and the device is synchronized with the speed of the paver so that the bars are driven to the required depth at 30-inch intervals.

A 1.9-inch-per-mile average profile index for the project reflects the degree of perfection now possible with slip form paving.

The major portion of class B PCC curb and gutter was placed with an extrusion type automatic curb and gutter machine. This was the first time that this type of machine was used in this area. Some difficulties were encountered in design and control of a mix that would work properly in this machine.

Experiments With Mixes

The contractor set the machine at a local commercial concrete batch plant and experimented with various mixes to obtain a mix that would work and he also added an augur to the machine to obtain satisfactory density. This machine utilized angle iron rails to control line and grade. With reasonable care in setting the rails the machine produced a nice appearing curb.

The 43 bridges and minor structures required 44,000 cubic yards of structure concrete, 10,280,000 pounds of bar reinforcing steel and 71,600 linear feet of piling.

All three contracts were characterized by high rates of production with an average of 1.8 million dollars in structures completed in a calendar year. The most spectacular operation was on the Wible Road Overcrossing where the contractor, Fredericksen & Kasler Corporation, poured 1,480 cubic yards of concrete during daylight hours by utilizing seven cranes and seven separate pouring crews. At the time this was a record structure pour.

Two Parallel Overheads

The Tumblin contract included two parallel 450-foot overheads spanning Santa Fe Railroad's Bakersfield Yard. These structures utilized 98 precast, prestressed concrete girders of 70- to 90-foot length. All 98 girders were built at the jobsite on temporary casting beds constructed adjacent to the railroad yards. Casting and stressing of girders was a continuous operation throughout this contract. A unique feature of this operation was the use of steel forms for the girders. It is believed that this was a "first" for a jobsite casting yard.

The Gordon Ball contract included a complex interchange at the north end of Bakersfield requiring eight structures within a quarter-mile area. Another interesting feature on this contract was the foundations for the center pier at the Minkler Underpass. In order to construct the new bridge without interference with existing traffic, 72-inch cast-in-drilled-hole concrete piles were used to eliminate excavation in the median adjacent to the traveled way. The "pile columns," as they are commonly called, are similar to those used extensively throughout Southern California but this was the first use in the State of 72-inch size.

The superintendents for the various contracts were M. H. Sandlin for Fredericksen & Kasler, Mike Saporetti for Gordon H. Ball and Jeff Manning for Tumblin Company.

SECOND LONGEST FREEWAY

A 16-mile section of the Antelope Valley Freeway, which ultimately will extend from the Golden State Freeway north of San Fernando via Soledad Canyon, Escondido Canyon, Palmdale and Lancaster to the Kern county line, was dedicated on August 23. The longest single freeway section ever completed in the State's history was a 21-mile segment between Barstow and Victorville, opened to traffic almost three years ago.

This new four-lane freeway, with provision for widening to six and eight lanes when future traffic requires, was constructed under two contracts.

New Legislation

More Funds for Local Roads; Scenic Highway Bills Passed

Additional revenue for city streets and county roads in California, based primarily on a 1-cent-per-gallon increase in the tax on gasoline, was provided by the California Legislature at its regular 1963 session.

The Legislature also passed, and Governor Edmund G. Brown signed into law, a substantial number of other measures which deal directly or indirectly with the state highway program and traffic operation.

From an organizational standpoint, the most significant enactment was Senate Bill 1019 (Chapter 1364), providing for reorganization of the Highway Transportation Agency and the Department of Public Works. (*See inside front cover of this issue for explanation of the changes involved.*)

The Legislature also manifested a stronger concern than ever with aesthetics in connection with the State's roads and highways, and passed a series of "scenic highway" bills and a plan for a system of roadside rests.

The "local transportation" measure (S.B. 344, Chapter 1852) was based on a series of studies which showed that cities and counties needed more revenue to keep up with their local street and road needs. By adding the 1 cent to the gasoline tax, effective October 1, 1963, and increasing weight fees 19 percent, effective January 1, 1964, this legislation is expected to provide about $70,000,000 a year to begin with, in addition to the revenue now apportioned to the cities and counties respectively from ⅜ of a cent and 1⅜ cents per gallon of the established gasoline tax.

Formulas Are Complex

The distribution formulas governing the extra 1 cent per gallon are somewhat complex, but the net effect is to make a little more than two-thirds of the new revenue available to the cities and just under one-third to the counties. Under the provisions of the bill, this new money must be expended on a select system of local roads and streets. Other provisions govern structural and geometric standards and various accounting procedures, including auditing and inspection by the State.



"This is a very important bill," said Governor Edmund G. Brown as he prepared to sign Senate Bill 1467, establishing a state system of scenic highways. "People will begin to appreciate its value when we put it into effect." Watching the Governor, left to right, are: State Senator Fred S. Farr of Monterey County, principal author of the bill; State Director of Public Works John Erreca; State Highway Engineer J. C. Womack; and Francis J. Carr, representing the California State Automobile Association.

Another feature of this bill involves rapid transit, enabling counties to increase the present in-lieu tax on motor vehicles (2 percent of market value) by one-half of 1 percent, the resulting revenue to be devoted to planning, constructing or operating a rapid transit system.

The scenic highway bills (S.B. 1467, 1468, 1469, Chapters 1788, 1793, 1794), were the outgrowth of studies by the Department of Public Works with the assistance of an advisory committee. They provide for a master plan of scenic highways comprising about 5,000 miles of state highway; for county scenic highways; and for memorial sites on scenic highways.

The roadside rest legislation (S.B. 173, Chapter 992), is also the result of interim study and a master plan drafted by the Division of Highways for an eventual total of over 250 highway safety rest areas. It will require an estimated $5,000,000 to construct these rest areas and about $1,000,000 a year to maintain them when the system has been completed. The legislation also transfers responsibility for maintaining 10 existing roadside rests from the Division of Beaches and Parks to the Division of Highways, effective September 20, 1963.

Measure Combines Policies

Both roadside rest and scenic highways policies are incorporated in a measure dealing specifically with the Westside Freeway (Interstate 5), with provision for co-ordinating the activi-

ties of several state agencies in developing both the highway and adjacent facilities (S.B. 581, Chapter 1758).

As reported in the May-June issue of *California Highways and Public Works*, the renumbering bill (S.B. 64, Chapter 385) was passed early in the session. It provides for streamlining the numbering system for state highways, and will involve some changes in long-established route markers between now and mid-1964.

A 70-mile-per-hour speed limit on full freeways was authorized by the Legislature in A.B. 2449 (Chapter 1735), contingent on approval by the Administrator of Highway Transportation of recommendations by the Division of Highways after conferring with the California Highway Patrol.

The steadily increasing cost of maintaining landscaping and other plantings on state highways was recognized by the Legislature when it passed S.B. 412 (Chapter 982). This measure excludes the cost of planting maintenance, currently estimated at $5,000,000 a year, from the 1-cent-per-gallon revenue limitation which applies to overall administration and maintenance expenditures of the state highway program. The same legislation places a ceiling of $7,500,000 a year on expenditures for maintaining plantings.

Two bills make two highway projects eligible for toll bridge revenue financing by defining them as bridge approaches. One (A.B. 1723, Chapter 1570) involves a connection to Grand Avenue in Oakland from the San Francisco-Oakland Bay Bridge; and the other (S.B. 50, Chapter 157), the state highway from Cordelia to the Benicia end of the Benicia-Martinez Bridge. Both projects require action by the California Toll Bridge Authority.

Fund for Research

The Budget Act of 1963 contained an appropriation of $150,000 from the State Highway Fund for research on highway safety to be conducted jointly by the Division of Highways, the Department of Motor Vehicles and the California Highway Patrol. These funds will permit continuation of a joint research program undertaken in 1961 under a $100,000 appropriation.

The annual state subvention for small boat harbors, hitherto $750,000, was increased to $2,000,000 under A.B. 239 (Chapter 2102). The money is appropriated from the Motor Vehicle Fuel Fund.

The Legislature passed only a few bills adding mileage to the state highway system. These were the sections between Eureka and the Samoa Peninsula; between Boonville and Ukiah; and between Mokelumne Hill and West Point. The Legislature also assured continued state responsibility for the Avenue of the Giants scenic route in Humboldt County by including it in the state highway system.

HELEN KLAUSER LEAVES; SERVED SIX DIRECTORS

Helen Klauser, administrative assistant to six State Directors of Public Works during the past 20 years, retired from state service at the end of August.

Mrs. Klauser's career with the State began in 1930 in Redding, where she joined the Division of Highways district office as a junior stenographer. Before that she had worked as secretary to the district attorney and as a deputy auditor for Tehama County for two years.



HELEN KLAUSER

A native of Packard, Iowa (the town was named for her paternal grandfather), Mrs. Klauser was brought to California as a child and grew up in Corning.

After graduation from high school there, she went on to graduate from Armstrong College in Berkeley and to attend the University of California.

In 1935 Mrs. Klauser transferred from Redding to the Division of Highways headquarters office in Sacramento, and the same year became a stenographer and personnel clerk in San Francisco for the late Charles H. Purcell, at that time engaged in the construction of the San Francisco-Oakland Bay Bridge in addition to his duties as State Highway Engineer. She continued to work for Purcell in his job of executive officer for the Golden Gate International Exposition, and returned with him to Sacramento in 1939.

She moved to the office of the Director of Public Works when Purcell was appointed to that position in 1943, and was promoted to administrative assistant in 1951.

In succeeding years she served in the same capacity for Directors Frank B. Durkee, C. M. Gilliss, T. F. Bagshaw, Robert B. Bradford and John Erreca, the present director.

Her responsibilities have included supervision of the secretarial and clerical staff of the director's office; the processing of a wide variety of legal and policy documents between the director's office and the various divisions of the department; and the scheduling of appointments for the director.

In the later capacity she has dealt with thousands of public officials and civic leaders from all parts of the State interested in the State's highway, bridge and building construction programs.

Mrs. Klauser is a member of Redding Chapter, Order of the Eastern Star, and of Alpha Omicron Pi.

Contractors' Bids Average 4.3 Per Job

The Department of Public Works advertised for bids in August on 41 highway projects with an estimated cost of $40,882,400. There were 52 contracts for $30,572,200 awarded during the month and 53 contracts for $17,447,000 completed.

Bids from 295 contractors were opened on 68 projects, an average of 4.3 bidders per project.

Cold Spring Canyon Arch

By F. H. YOSHINO, Resident Engineer, and R. L. WHITAKER, Project Designer



Motorists driving from Santa Barbara to Lake Cachuma and Santa Ynez by way of San Marcos Pass (State Sign Route 150) will soon be traveling across one of the 10 longest* steel arch bridges in the United States.

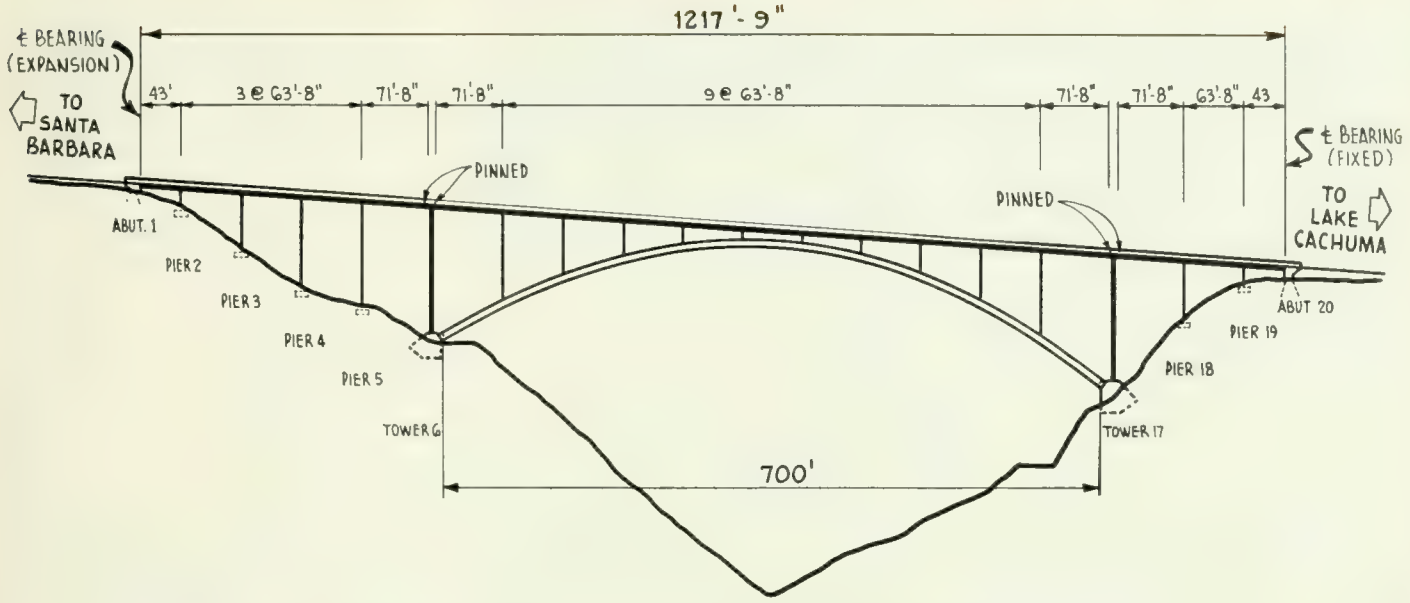
* Reference World Almanac, 1963.

Route 150 follows in general a trail used by early-day travelers between Mission Santa Barbara and Mission Santa Ynez. In 1846 Lt. John Fremont and his troop crossed San Marcos Pass to surprise a Mexican Army contingent waiting in ambush at Gaviota Pass to the north. The trail was later used as a stagecoach route. Cold Spring Tavern, one of the original coach stops, is at the side of the present route about one-half mile upstream from the bridge site. The original trail intersects the new alignment near the north end of the bridge. The trail is clearly defined and was used by survey crews to gain access to the bridge site.

Traffic on this scenic and historic route has increased over the years as the attractions of the Missions, Solvang, the quaint Danish community, and the recreational facilities of Lake Cachuma became more widely known.



The final segment of the arch is placed at the crown. Flags are attached to the closing segment in the traditional way of signifying the successful completion of the job. The arch was lowered until bearing was obtained at the crown by releasing pressure from the jacks at the base of the temporary towers.



A profile of the bridge showing some general dimensions and the numbering of the towers and piers.

The present road no longer provides adequate service for the traffic volume.

Part of Major Improvement

The bridge, which is located about 13.5 miles north of Santa Barbara, is part of a major improvement in alignment and grade of Route 150. About seven miles of road are presently under construction in the vicinity of San Marcos Pass summit. The bridge eliminates approximately one mile of road which would otherwise curve in and out of the canyon. Savings in time and money were thus achieved. The panoramic view of the canyon and surrounding countryside from the bridge and approaches will surely rank as one of the more beautiful and impressive of California's many scenic splendors.

The bridge and road work are being performed under two separate contracts. At the time this article was written it was anticipated that the road work would be completed in February 1964. The bridge is scheduled to be completed in November 1963.

The bridge is 28 feet wide between curbs and 1,218 feet long overall. Welded steel girders, floor beams, columns and two main towers support the concrete deck. The 700-foot arch span which rises 400 feet above the canyon floor carries 11 girder spans. Eight side spans flank the main span. The arch and main towers are supported by concrete skewbacks. The approach columns rest on concrete piers. Concrete abutments support the end spans.

Curved Box-shaped Arches

All structural steel for this bridge was A-7 or A-373 type. One thousand four hundred forty tons of steel plate were formed into two gracefully curved box-shaped arch rib sections each nine feet deep by three feet wide. The box shape is made up of 2 web plates 15/16 inch thick joined by 2 flange plates of different thicknesses

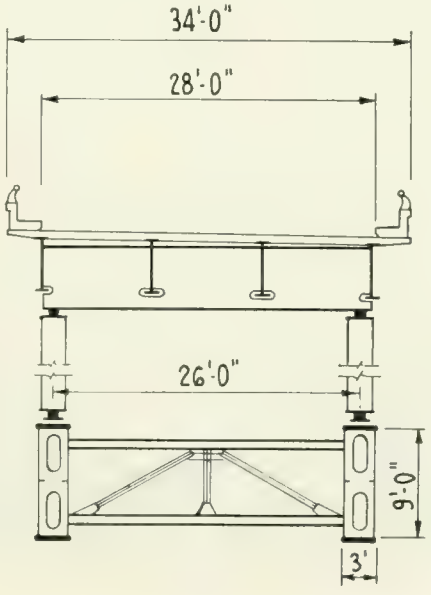


Diagram of a typical section of the bridge.

ranging from 1½ to 3½ inches. Welding was specified for all shop splices and high-strength bolts were required for all field connections. The 2 ribs 26 feet apart are connected by trussed steel bracing. Steel pedestals were welded to the ribs to form column bases.

The arch was designed to be erected as three-hinged with provision for conversion to two-hinged following placing of girder steel. Deck concrete for the arch spans was required to be placed in a particular sequence which was designed to minimize unbalanced loadings during construction.

Design live loading was A.A.S.H.O. H20-S16 classification without reduction due to the length of span.

Each rib carries a dead load thrust of 2,600,000 pounds which increases to 3,000,000 pounds under design vehicle loads. The maximum design moment on each arch rib is about 12,000 foot-kips.

The arch is capable of carrying loads equal to 1.8 times design dead load plus live load, without permanent distortion of any member.

Arch Deflection

Under maximum uniform design loading the deflection of the arch at the crown will be approximately three inches and under unsymmetrical loading the maximum deflection will be approximately six inches at the one-quarter point.

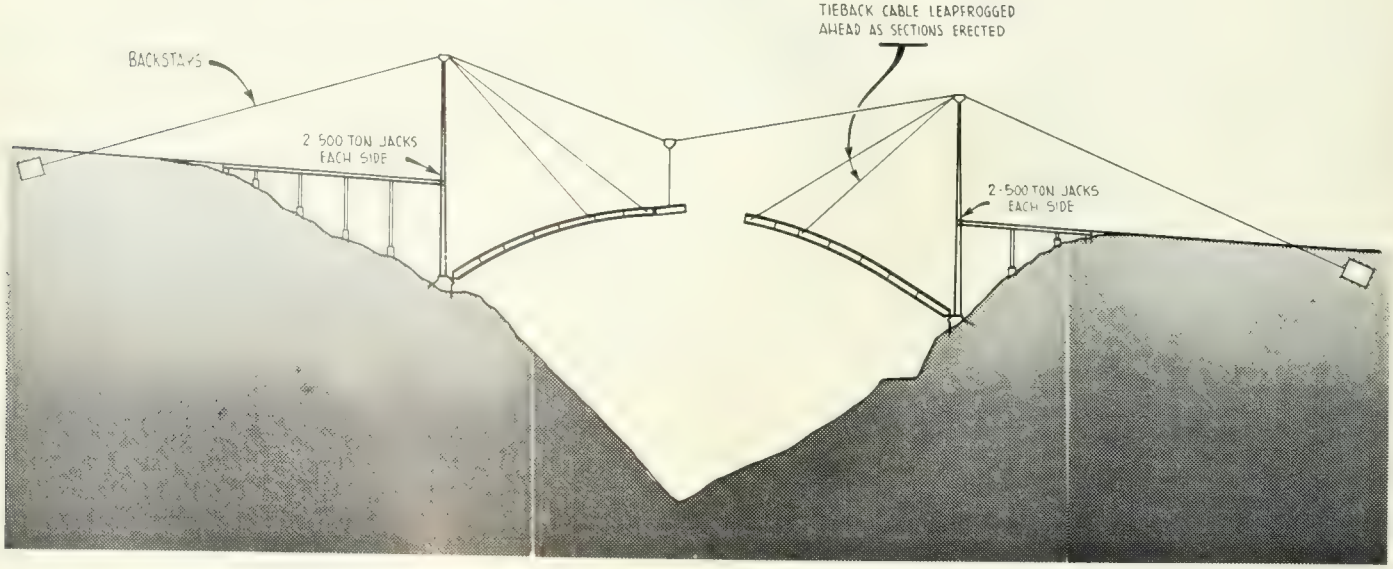


A view from Abutment No. 1 (toward Santa Barbara) showing spans 1 through 4 and the traveler crane in position to set steel for main tower 6 and the girders of span 5.

Two cables each 1⅞ inches in diameter are concealed near the crown of each rib. These cables connect each rib to the deck. The deck is anchored to the abutment at the north end and therefore the cables tend to restrain the arch crown against translation thereby reducing arch deflections under unsymmetrical loadings.

The ends of the arch rest on hinge pins eight inches round by three feet long. These pins are supported by steel castings which in turn rest on concrete skewbacks. The skewbacks transmit loads from the arch and main towers directly to bedrock which consists of massive bedded sandstone of the Gaviota Formation of the Eocene-Oligocene age.

Eight hundred ninety tons of steel plates were formed by welding into shapes for towers, columns, floorbeams, and girders. Each main tower is 134 feet high consisting of two four-foot square legs connected by one cross strut at the roadway level and two struts at about the one-third points. Each leg is anchored to the skewbacks by 29 1⅜-inch round prestressing rods. The rods are about 25 feet long. Each rod was required to be preloaded to 131,000 pounds in order to secure the tower to the base and prevent uplift under all design loadings. The towers act to support



ARCH ERECTION

This diagram shows a profile of the arch erection technique used on the bridge.



The four photos on this and the next page show a time sequence of the arch erection procedure.

girder loads and to carry lateral loads from the deck system to the foundation.

Columns Are Hinged

Twelve columns support the approach spans and 20 columns carry the spans on the arch. Each column is a two-foot square, sealed, welded box section which is hinged at the floor beam and at the footing or top of arch to permit relative movement of the deck due to temperature changes or arch translation due to unsymetrical loadings.

A slender column effect is obtained because of the column height which reaches 93 feet at pier 5.

The columns were designed with no bracing of any kind and were required to be fabricated full length without field splices to further enhance the effect of slenderness.

Each approach span column is supported on an individual concrete footing which in turn rests on bedrock similar to the material at the main arch support.

Four girders four feet four inches deep spaced nine feet four inches apart support the concrete deck. The deck and girders have joints at the abutments and towers only. Girder spans are continuous for vertical loadings for each approach span group and for the group of spans between towers. The entire deck was made continuous from abutment to abutment by utilizing a hinge detail at each tower which permits vertical rotation of the deck and girders but not horizontal rotations. Shear is transferred across the joints by a key detail, thus the deck and girders act as a horizontal continuous beam with the abutments, main towers and arch ribs acting as supports to resist horizontal loads from wind or earthquakes.

Slotted Floor Beams

Continuity for the girders across the floor beams was obtained by slotting the floor beams to match the girder flanges. This permitted installation of bolted field splice plates for girder flange connections. Girder web connections to the floor beams were made in the usual manner with angle connections to the floor beams.

Girders were made composite with the concrete deck. A steel lateral system was installed near the lower flange of the girders. Both the steel bracing and the deck act to resist horizontal loadings. The girders support a 7¼-inch concrete deck which is 28 feet wide between type II barrier railings. Each railing is three feet seven inches high with a two-foot-wide curb. The total width of deck is 34 feet. The concrete deck is reinforced longitudinally, as well as transversely, to act in conjunction with the girder bracing system to resist lateral loadings. Deck units were required to be placed in a sequence designed to reduce the effects of concrete shrinkage. The longitudinal reinforcing and composite action of the girders resists any tendency toward cracking.



Further segments have been added to the arch. The temporary erection towers and high-line rigging are in position on top of the permanent main tower at each end of the arch.



The arch is nearly completed. Note the safety nets under the arch.

Abutment No. 1 at the end nearest Santa Barbara rests directly on bedrock. Abutment No. 20 is supported on steel pilings which were driven to bedrock. The deck is tied to Abutment No. 20. Expansion takes place at Abutment No. 1.

Abutment 20 supports both the vertical loads from girders and vehicles and the longitudinal loadings due to live load traction and loads from the cross tie cables at the arch crown.

Rugged Terrain

The accompanying photographs show the rugged terrain at the bridge site. Surveying to the high degree of accuracy necessary with this type of construction in this terrain posed problems not commonly encountered in bridge work. To assure the required accuracy, horizontal distances across the canyon were measured by five separate methods. They were: slope chaining, direct chaining, subtense bar, triangulation and by geodimeter measurement. Triangulation results were discarded because the short base lines and large vertical angles required introduced errors which could not be eliminated. Results of the remaining methods agreed to within ½ inch in 740 feet or an accuracy of about 1:18,000.

A giant slingshot composed of two very elastic rubber bands, normally used for exercising, was used to put the first line across the canyon. This was done in order to pull a 600-foot chain over the top of the dense growth of trees and brush. Level circuits were run along the existing road and across the canyon.

The contract was awarded to the United States Steel Corporation, whose American Bridge Division did the steel erection. In June 1962, Massman Construction Company of Kansas City, Missouri, moved on the site. They were the subcontractors for the excavation and concrete work. Foundation work began on the south slope, progressed downhill and across to the other side of the canyon.

Hand Tools Used Extensively

Due to inaccessibility of the footing sites very little heavy equipment could be employed for excavation and concrete work. Hand tools and air jackhammers were used extensively for excavation. Concrete was transported from transitmix trucks to footings and skewbacks by a machine which pushes the concrete through a pipe by air pressure.

Concrete was dry batched in Santa Barbara and transported in dump trucks to a transfer plant at the San



The arch completed. All temporary support cables are removed and the arch is self-supporting.

Marcos Pass summit. At the transfer plant transitmix trucks were waiting to be belt loaded with the dry batch and to have water added. This arrangement made it possible for the contractor to have concrete at the worksite in the minimum amount of time, and also to have better control of the rate of delivery.

Grinding was required for the arch and tower bearing surfaces on the skewbacks. This was a major job considering that areas which were as much as 24 feet square had to be ground to within $\frac{1}{32}$ inch of a true plane. Grinding was done with portable electric-driven hand grinders. Results were checked with a scratch template.

The arch segments and arch lateral bracing were fabricated by the American Bridge Company at their plant in Gary, Indiana. All other structural steel was fabricated at the Maywood plant near Los Angeles. Steel was shipped by rail to Santa Barbara and trucked to the site.

Shop inspection of the work done at Gary was performed for the State by the R. W. Hunt Company, under provisions of a service agreement. The Division of Highways Materials and Research Department performed shop inspections for all other work.

Additional tests, sufficient to assure suitability of delivered materials, were performed by the materials laboratory at the request of the resident engineer during progress of the work.

Erection of structural steel began October 30, 1962. The south approach spans and tower were erected first, as shown in the photo on page 16. A traveler crane was assembled on span 1 and moved forward on rails to erect the next four spans and high-line tower. The traveler was then dismantled and reassembled on the other side of the canyon at abutment 20, and the same procedure repeated. Temporary guys and bracing were used at bents and at the top of girder flanges during erection to provide increased stiffness until the deck was in place.

High-line System

A high-line system was used to erect and support the arch during construction and to place superstructure steel on the arch. A high line consists essentially of a suspension bridge having special equipment for transporting loads along the main cables.

The 120-foot high-line towers were placed on top of the 134-foot high skewback towers. The function of the temporary towers was to carry the high line and to support the arch during erection. The high-line towers were free to rotate at the bottom in the direction of the centerline of bridge. A pair of 500-ton hydraulic jacks were put under each leg to provide a high degree of control over the vertical position of the towers. Both the erection towers and traveler crane have been used on similar jobs.

Five miles of cable were used for the high line, arch tiebacks, and backstay lines shown in the photographs. During operation, three hoists were used to control the moving cables. A carriage, riding on rail, atop the erection towers provided for transverse movement of the high line.

Rib sections were transferred directly from trucks parked on the existing road near the north skewback to the high line and then into position in the arch.

Communications between the contractors' key personnel were maintained by use of citizens band transceiver radios. The advantages of this radio system can be appreciated when it is recognized that each of the two hoist operators (one near each abutment) were hundreds of feet from the point of picking up the rib segments and seldom could see the load being lifted or set.

Tieback Tables

As succeeding sections of arch were placed outward from each skewback, tieback cables from the erection tower to rib were set near the end of the newly placed segment and the preceding tieback cables were released. This procedure was repeated until the last section of rib was in place at the crown. All field connections were made with high-strength bolts. The arch was intentionally erected higher than the intended final elevation so that by releasing pressure from the hydraulic jacks at the base of each erection tower the arch halves could be lowered until bearing was obtained at the crown hinge. This delicate and critical operation was completed on



The final operation of setting girder spans on the arch. Girder span 7 is shown in position. Upon completion of this operation all highline rigging and temporary bracing are removed.

Seattle Public Library
NOV 13 1963



The steel structure as seen from downstream. The deck and railing remain to be completed. The bridge will be painted green as a final operation. The existing road can be seen in right foreground.

June 27, 1963. The "topping out" or in this case the closing operation was celebrated in the traditional manner by raising the "Stars and Stripes" with the final rib segment, signifying the successful completion of a difficult and noteworthy task. Erection of the rib segments was completed in 60 working days.

The arch became self-supporting when the two halves were lowered into bearing at the crown hinge. All tieback cables were then removed and erection of the columns, floorbeams and girders on the arch was begun. Each floor beam and column was raised and set as a unit. The four girders were then placed and bolted in each span. The final piece of structural steel was set on July 25, 1963. A total of 8 months and 25 days elapsed between setting the first and last pieces of structural steel. The crown hinge was then bolted rigid, as planned, thus converting the arch from three-hinged to a two-hinged type.

Accurate Within One Inch

Surveys on the arch after all structural steel was in place show that the arch curve actually obtained was accurate to within one inch in elevation compared to the theoretical elevations planned. This is within anticipated variations for this type of work. Final adjustments will eliminate all variations in the deck profile.

The high-line rigging and towers were removed during August 1963 and placing deck concrete on the arch spans was commenced. Deck concrete for the approach spans was placed while the arch erection was underway. All deck concrete was placed by labor crews using "Georgia Buggies."

Concrete for deck spans on the arch was placed in a special skip pattern specified by the designers. The purpose of this placing pattern was to keep the arch from deflecting excessively under the unbalanced loadings and also to minimize deck cracking resulting from normal shrinkage of the concrete. A specially designed rolling frame was used for stripping deck falsework. This frame rolls on the completed deck and has two platforms which extend under the deck. The platforms are hinged in such a way that they can be raised or lowered by operators on the deck. This machine thus eliminated the need for conventional working platforms under the deck.

The bridge will be painted green as the final operation.

The contract bid cost was $1,948,-638 which includes about one-fourth mile of approach grading necessary to provide a working area for construction of the bridge. Three hundred working days were allotted for completion of the contract.

The Cold Spring Canyon Bridge is one of the first major arch structures to use all welded sections. This feature combined with the unusual arch proportions, the picturesque setting and the generally pleasing appearance make this structure a notable addition to the California highway scene.

Top 10 Percent

Nation's First Right-of-way Academy Prepares Picked Group of Young Men

By RUDOLF HESS, Chief Right-of-way Agent

California's 14,000-mile state highway system has been built, almost entirely on lands which had first to be purchased from private owners. The job of appraising these lands, negotiating their purchase, and managing them until construction is scheduled, falls to a technically trained state employee called a right-of-way agent. The first California right-of-way academy, recently instituted on the campus of the University of California at Davis, represents an innovation in training procedures for new employees in this field.

An intensive recruiting campaign during the last college year interested nearly 600 young men in careers as right-of-way agents with the California Division of Highways. Typically few, if any, of the applicants had previously considered a future in right-of-way; none had prepared themselves for such a career in their courses of study.

A composite picture of the typical applicant would show a liberal arts graduate who was attracted by the challenge implicit in the task of appraising, acquiring and managing over 9,000 separate parcels of land required for highway purposes each year. He would be tempted by the promise of a basic education in several professional specialties; by the varied responsibilities a right-of-way man is expected to assume; by the chance to help build something of usefulness and permanence.

600 Applicants

Nearly 600 applicants sought a right-of-way career, but fewer than 10 percent survived a rigorous testing and interview procedure designed to eliminate all but the most promising. The top 10 percent, all hired and sent to one or another of California's 11 highway district offices, began their new career with the knowledge that they would have to begin the learning process all over again.

Among right-of-way professionals throughout the nation, the California Division of Highways has been noted



Right-of-way Academy students leave a class held in the auditorium of the Physical Sciences Building at the University of California at Davis.

for many years for the excellence of its comprehensive educational programs. With the co-operation and assistance of the Extension Division of the University of California and of the American Institute of Real Estate Appraisers numerous on-the-job and after-hours training programs have been offered to right-of-way men in each of Highways' district offices.

California's long experience in right-of-way education was recently tapped by the American Association of State Highway officials and an outline of a course of study along with tried and proven educational materials was prepared for use in other state highway departments. Although the course outline was not formally published by the AASHO Committee until late 1962 several states have already begun programs based on the material furnished.

AASHO Program Used

Work on the AASHO program provided the perfect opportunity for a critical analysis of California's own educational offerings. Program content was found to be excellent. A practical working knowledge of right-of-way policies, procedures and techniques formed the solid backbone of information being passed on to new employees.

The analysis did, however, bring the suggestion that instructional techniques could be improved. Past educational programs have been conducted separately in each district office and instructional personnel were drawn from the ranks of each district staff. Although basic content was the same, instructional quality would naturally vary with the people involved and with the environment in each district.

COURSE OUTLINE

The R/W Function; its Proper Place in Highway Department.
- (a) Introductory
- (b) The Training Program
- (c) State Highway Department
- (d) Right-of-way Structure, Function
- (e) Right-of-way Relationships

Property Acquisition Law
- (a) Basic Laws Covering Acquisition of Property for Public Use
- (b) Case Law Pertaining to Access Control and Severance Damages
- (c) Condemnation Procedures

Basic Engineering
- (a) Mensuration
- (b) Maps and Descriptions
- (c) Construction Plans

Appraisals
- (a) Basic Principles and Methods
- (b) Case Study Problems
- (c) R/W Appraisals

R/W Research and Development
- (a) Legal Aspects of Damage—Benefit Determinations
- (b) Objective Measurement of Damages
- (c) Land Economic Studies

Negotiations
- (a) Land Title Law
- (b) Contract Law
- (c) Techniques and Psychology
- (d) Case Study Problems

Property Management
- (a) Rentals
- (b) Clearance
- (c) Excess Land Sales
- (d) Relocation Advisory Assistance

Examinations

There was need of a uniform instructional pattern designed to give students a single high quality of instruction and to impart a nonparochial feeling of belonging to an organization having objectives which would be of ultimate benefit to all Californians. It became evident that these goals could best be reached by gathering all new employees at one location so that the finest instructional talent available could be used without the disruption to continuing work programs which would be necessary if the course of instruction were given in each district.

Based on Educational Needs

The first session of the California Right-of-way Academy on the campus of the University of California at Davis during the first two weeks of August was the culmination of a series of major revisions in management's thinking on the educational needs of entering employees. Actually, the academy concept is only the first of a number of proposed changes in future educational policies, having been designed to prepare entering level right-of-way agents for future job assignments. Formalization and changes in techniques and emphasis are planned throughout the entire educational and intraining program structure of the Division of Highways.

Orientation training for new right-of-way agents has been planned and



Bixby Hall, on the University of California Davis campus, where academy students were housed during the two-week session.

organized to provide basic skills and knowledge directly related to the department's policies and procedures and job performance requirements. The district training programs, in operation since 1950, have consisted of 100 hours of concentrated instruction spread in weekly sessions over a one-year period. Course content, of course, has been subject to continual critique and sharpening during the last 13 years which simplified the pre-academy analysis considerably. The basic structure which has been in use was retained but content was considerably strengthened in light of the continuity which would be possible with daily classroom instruction.

The analysis of course content proved to be a relatively simple task compared to the multitude of minor but necessary arrangements which had to be made once detailed planning for the academy began. Transportation, meals, housing, reading assignments, visual aid equipment, instructor assignments, detailed lesson plan construction, and examination content were just a few of the considerations complicating progress toward the first academy session. These, and many other, major and minor details necessitated a host of decisions and extremely close co-ordination during the preparation period.



The quiet Town of Davis and its rapidly growing branch of the University of California was the site of the Division of Highway's Right-of-way Academy.

Overall Responsibility

Overall responsibility for creation of the academy and its course of instruction was assigned to Harry L. Kagan, Supervising Right - of - way Agent in charge of Research and Development. His major tasks were to delegate his authority for detailed preparations to capable people and to act in an advisory and co-ordinating capacity for overall academy continuity.

Lesson plan preparation in each of the major divisions of right-of-way work was made the responsibility of the administrative heads of functions involved. For academy purposes these positions were titled unit co-ordinators. The unit co-ordinators in turn chose instructional personnel from among the senior members of the statewide right-of-way staff. All had an extensive knowledge of the right-of-way function and a specific knowledge in depth of the particular unit which they were to teach. In addition nearly all had had prior experience in instructing various courses of study given in past years at the district level.

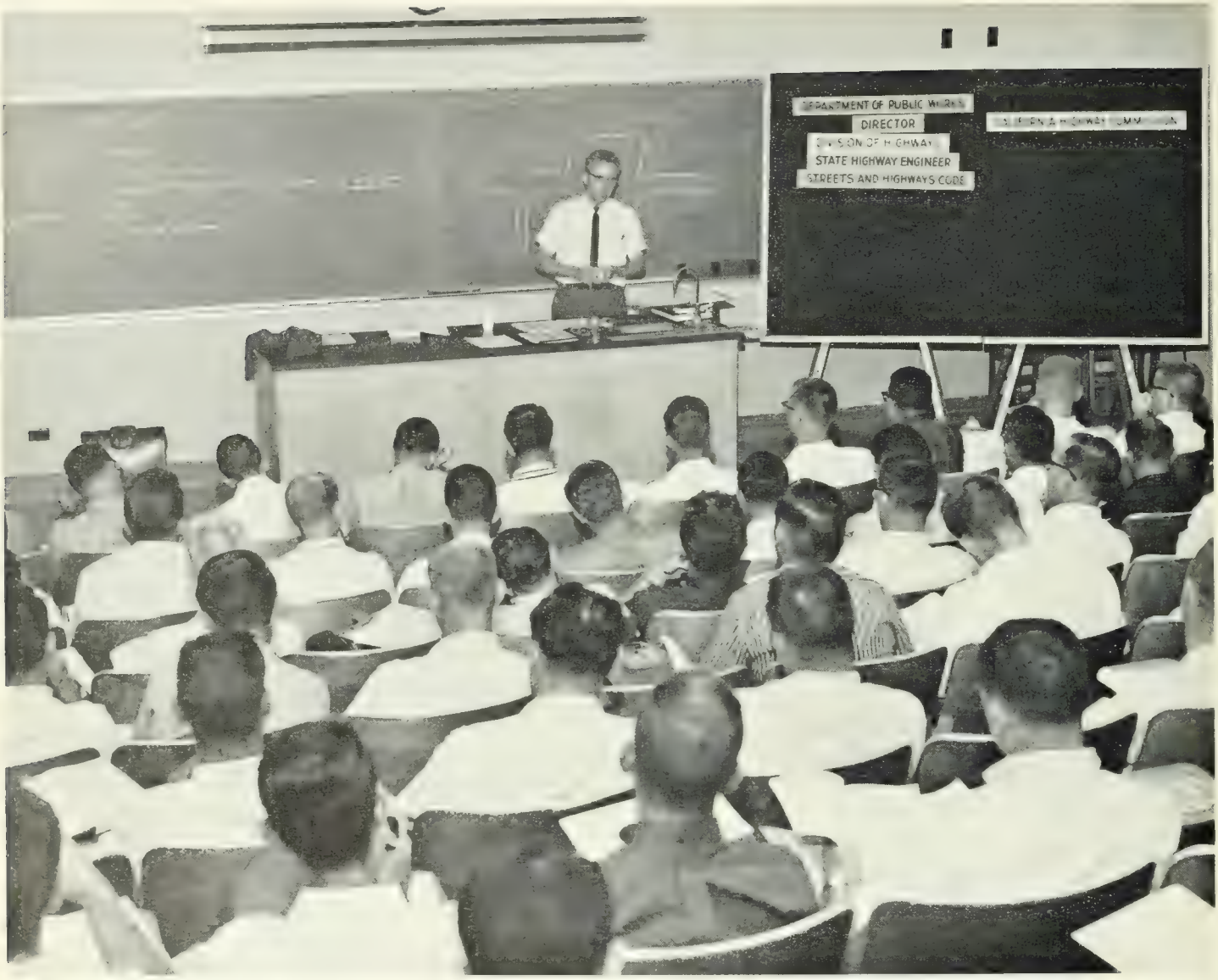
Following the selection of instructors, and as a first step toward the formal preparation of the course of instruction, the Division of Highways training officer conducted a refresher course in instructional techniques. The course, in the form of a guided round table discussion, covered preparation of lesson plans, use of visual aids, theories of learning, methods of self-evaluation and a final comprehensive discussion of total program concepts and objectives. Discussion on this last point provided some of the most interesting moments of the faculty training period.

Unanimous Agreement

A clear and unanimous agreement on the ultimate objective of any proposed course of action is the basic ingredient of success and it is particularly important in a case where many variations of emphasis are possible. But right-of-way work itself is tremendously varied; it requires skill in several technical areas and a long period of testing and training is required before a new employee can competently and satisfactorily represent the Division of Highways, the public, and the individual property owner in equal measures. The work requires that attitudes be as well developed as are skills, and to be successful in his career, the future agent must be prepared for the working conditions which apply in a civil service organization. The nature of the agents' future needs, then, required that several basic objectives be held firmly in mind by the instructional staff.

First, the student had to be equipped with a knowledge of the *ideals and philosophy* of the Division of Highways; he had to know how and why it worked. This called for both a specific presentation of mechanics and a strong idealistic exposition of motives.

Second, the student had to be given a *basic technical kit* which would enable him to understand and apply his future on-the-job training. Here a selection had to be made of a maximum number of key points for inclusion in lesson plans.



Senior Right-of-way Agent T. L. Carlson instructs a class in highway organization and property acquisition law.

Proper Attitude Is Vital

Third, the student had to be imbued with the attitude that the *rights of the public and the property owner had to be equally protected*, and that the policies and procedures of the Division of Highways were adequate to achieve this end. This meant that the instructors had to be highly skilled and thoroughly prepared and that presentations had to be absolutely factual and unbiased.

Finally, the boundaries and restrictions applying to *civil service* had to be completely and honestly explained to give the student a basis for a realistic appraisal of his future.

Within the context of these basic objectives, the methods of instruction were formalized during preparation of lesson plans. Under the direction of the unit co-ordinators, lesson plans were analyzed, and it was decided: where the lecture method would be most appropriate; which sections would be most effective with class participation; which lent themselves to homework assignment and discussion under the case study method; and where each of the various types of visual aids would be most effective.

With these initial decisions preacademy study assignments were selected for the students. Certain of the study materials were completely self-explanatory and would be useful as a preindoctrination. Since almost all of the students had reported for work before the academy was scheduled to begin, this technique had the advantage of easing them into study habits and generally preparing them for what was to come.

Finally the academy co-ordinator, with the help of individual unit co-ordinators, integrated reading assignments, the separate lesson units and the insession homework assignments so that emphasis was placed on the interrelationship of the various operations of right-of-way within the overall right-of-way function. The final result was a demonstration of the practical application of lesson material to realistic situations. Nearly every point was related to a realistic situation within the realm of the students'

understanding and experience and this proved, during the course, to be an extremely effective method of presentation.

Positive Motivation

One extremely important element in any educational program is a positive motivation for the student. Of course, in job-oriented training the student is largely self-motivated or rather, he should be, since the training is essential to his future progress. A unique feature was, however, included in the academy which furnished greater incentives to the students. Junior right-of-way agents who complete the course of instruction and the final examination will qualify as having passed, when they are eligible, the written test requirements for promotion to assistant right-of-way agent. The student's performance at the academy, as evidenced by his relative standing in the class, when combined with his subsequent job performance will determine his advancement to a higher classification and salary.

Provision was made of course to continuously evaluate the instructors and instructional material while the academy was in session. Each individual unit co-ordinator monitored his entire session, checking for adherence to lesson plans, completeness of instruction, and timing while at the same time critically reviewing lesson plan content. Additionally the training officer and his staff observed and commented on instructional techniques, presentation, use of visual aids and class response. The instructors themselves were expected to complete a self-evaluation particularly noting strengths and weaknesses in the lesson plans and in their own technical presentations.

In effect all plans and preparations for the academy were on trial and were subjected to a very critical analysis so that the effectiveness and future of the academy could be realistically appraised.

Eleven Days of Classes

Class sessions were scheduled for a total of 11 strenuous days, 6 days the first week followed by 5 full days the second week. The volume of technical material to be transmitted made it necessary to hold classes for a full eight hours each day. In addition, reading assignments, problems and case study materials were given to the students as homework. The students were lodged in Bixby Hall, one of the new, comfortable dormitories on the Davis campus, and all meals were served at the Student Union Cafeteria. These arrangements cut distracting influences to a minimum and provided nearly ideal conditions for study. In fact, it was reported that study sessions continuing until two in the morning were not uncommon.

To ease some of the pressures on the students, the instructors in each unit spent their evenings in the dormitory lounges and made themselves available to assist individual students or to participate in general "bull sessions" covering many phases, techniques or procedures for which time had not been allowed in lesson plans. These evening sessions proved to be excellent yardsticks by which the instructors could measure their own effectiveness as well as the capacities of their students. It is probable that this extra little bit added by the instructors contributed more to the development of an *esprit de corps* among the new agents than any other single factor.

Esprit de Corps

Esprit de corps is an intangible factor, but one which must be developed to have a successful organization. Such a feeling is extremely difficult to induce in a new employee and usually only comes after a long period of training under ideal circumstances. The development of a feeling of belonging in a large organization, especially in a new employee, is really a bonus and was one of the benefits of the academy concept which was not consciously anticipated to any great extent before the course began. Subsequent reactions from the students and from their superiors in the dis-



Students work on a problem given by the instructor at one of the Right-of-way Academy classes.



Charles Newman, junior right-of-way agent assigned to the San Francisco District office, reviews his evening reading assignment in the student dormitory.

tricts were so good, however, that future academy sessions for new employees are assured.

These reactions are in effect a second-level evaluation which began the moment academy students returned to their districts; and this will actually be the most important evaluation of all. The first line supervisors in each district have the responsibility for continuing on-the-job training and for rating their subordinates performance on the job. The academy graduates will be closely watched for visible signs of enthusiasm and improved productivity and in the final analyses an enthusiastic, well-adjusted, productive right-of-way agent staff will be proof of the success of the academy concept and approach.

Division Publishes New Right-of-Way Booklet

A new 24-page booklet on right-of-way acquisition policy entitled *Your Property, Your State, Your Highways* has been issued by the State Division of Highways.

Prepared especially for people whose property may be needed by the State for highway or freeway construction, the booklet explains in easy-to-read terms the State's obligations to the owner in purchasing his land for public use.

In addition to being distributed to affected property owners the booklet is also handed out at public meetings and hearings on proposed freeway routings.

Specific topics explained by the booklet include the method of determining a highway location, how the property owner will be contacted, how a fair price is decided upon for his property, some advantages in selling his property to the State over a private sale, damages paid for remaining property, how he may move his old home to a new location or purchase a new home before he is paid for the old one and transference of GI and Cal-Vet loans.

The new booklet replaces the division's previous brochure *16 Million People Want My Property*.

Nondiscrimination Policy Reiterated

Director of Public Works John Erreca has called on all employees of the Department of Public Works to take positive action to make the department's long-established policy of nondiscrimination fully effective within the organization.

"Simply being against discrimination will not make this policy effective," Erreca said in a general circular issued to the department staff, including the Division of Highways, Division of Architecture, and Division of San Francisco Bay Toll Crossings.

"It is the policy of this department that employees shall be appointed, assigned, trained, evaluated and promoted on the basis of merit and fitness without regard to race, color, religion, national origin, or ancestry," Erreca said.

He cautioned that equal consideration of minority personnel must be accomplished in all phases of the civil service process.

The circular was issued in accord with the Governor's Code of Fair Practices, and Erreca said that positive action on nondiscrimination would enable the department to show substantial progress in its annual report as required by the code.

The circular contained specific instructions under the headings of appointments, recruitment, promotions, qualifications appraisal panels, evaluation and training. Copies of the circular (General No. 73) were placed in the hands of all employees of the Division of Highways by order of State Highway Engineer J. C. Womack.

WRONG RIVER

Inside the front cover of last month's issue the river shown in the photographs was called the "Truckee."

This was one of those mental lapses no one caught in time. It was really the South Fork of the Yuba.

The Truckee runs in the other direction and is on the other side of Donner Summit.

Westside Progress

Construction Starts on New 321-Mile Interstate 5 Route

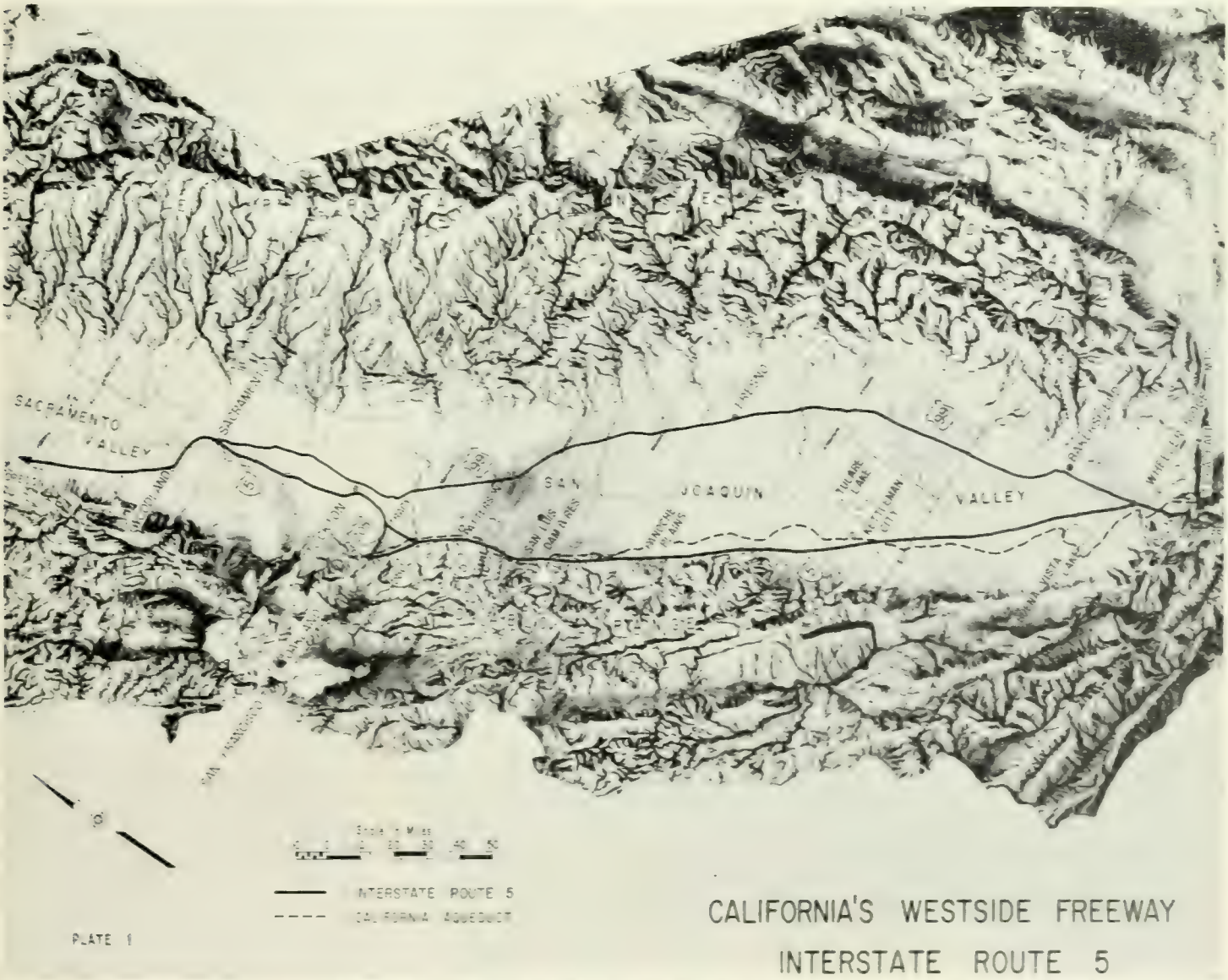
By M. E. CORNELIUS, Assistant Engineer of Design

Construction has started on the longest freeway project on entirely new alignment ever undertaken by the California Division of Highways. Actually the first construction work of consequence on this California freeway is being done by the United States Bureau of Reclamation.

The work being done by the Bureau of Reclamation for the Division of Highways is on Legislative Route 238 which, when completed, will be signed as Interstate Route 5. Legislative Route 238 extends for 321 miles, most of it completely new alignment up the west side of the San Joaquin Valley between U.S. 99 near Wheeler Ridge, some 40 miles south of Bakersfield, and U.S. 99W near Woodland.

The routing for this freeway has been adopted throughout by the California Highway Commission as has the routing for that 16-mile piece of Interstate Route 580 which is needed to connect Interstate Route 5 to existing U.S. 50 west of Tracy. This 16-mile freeway connection is required to serve Bay area-Southern California traffic desiring to use Interstate Route 5 southerly of Tracy.

The location of these routes along the west side of the Central Valley is indicated on Plate 1. Because of the



The Westside Freeway extends from U.S. 99W near Woodland to Wheeler Ridge south of Bakersfield, a distance of 321 miles.

route's location in relation to the Central Valley, it has been known locally as the Westside Freeway from its inception. (See "Westside Freeway," *California Highways & Public Works*, September-October, 1960.)

Also indicated on Plate 1 is the general route which will be followed by the California Aqueduct as it runs from the San Joaquin-Sacramento Delta to the Tehachapi Mountains. This aqueduct is a key feature of the California State Water Project. It will transport surplus water from Northern California to areas of need in California's great Central Valley and south of the Tehachapi Mountains.

State Facility

From the Sacramento-San Joaquin Delta to the San Luis Reservoir west of Los Banos the aqueduct is to be a state facility for which the California Department of Water Resources is responsible. From San Luis south to Kettleman City (including the San Luis Dam and related facilities) the aqueduct is a joint state-federal undertaking for which design and construction responsibility has been assigned to the U.S. Bureau of Reclamation. The State will operate the joint unit. Southerly from Kettleman City the aqueduct again becomes a state facility.

The reason for the joint undertaking by the state-federal water agencies between San Luis and Kettleman City is that the San Luis Creek basin is the only area where economic water storage can be obtained on the west side of the San Joaquin Valley. Federal interest entered into the picture because the increasing demand for irrigation water on the west side of the valley created the need to extend the reclamation features of the federal Central Valley Project southerly from the U.S. Bureau of Reclamation's Delta-Mendota Canal service area.

The most economical way for the federal government to do this was to use the offseason capacity of the Delta-Mendota Canal by pumping this water into a storage reservoir on San Luis Creek from which a canal could be constructed southerly to near Kettleman City. By co-operating in financing the construction of larger facilities both state and federal water requirements through this area could be satisfied at a minimum of overall cost.

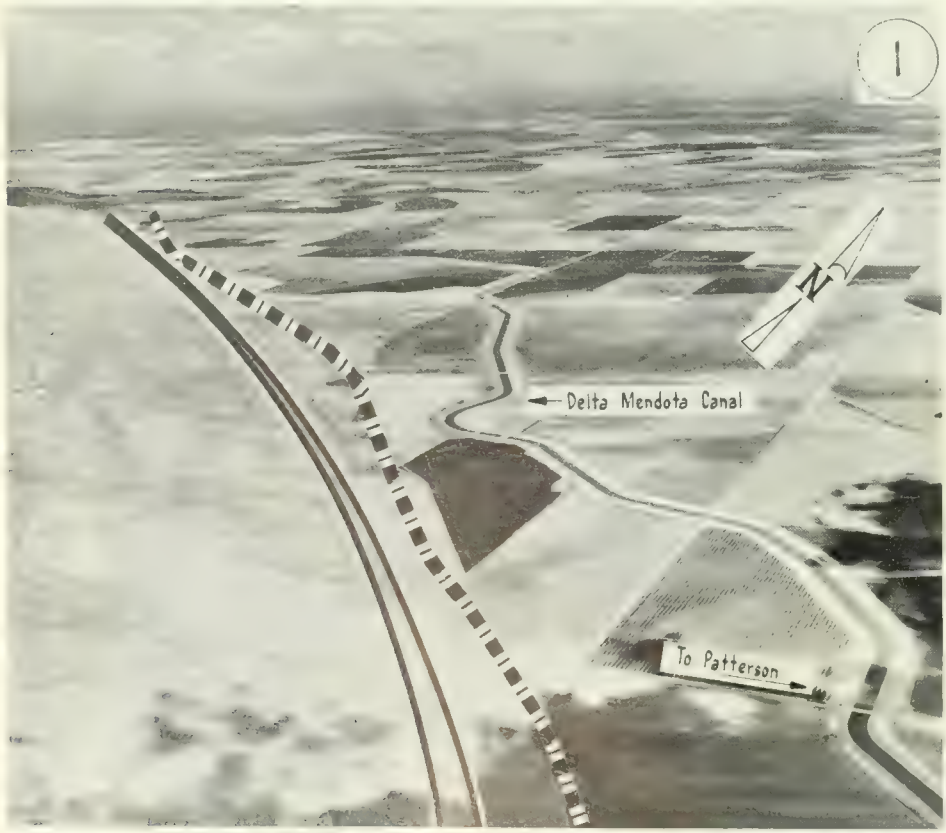
Plans Are Complete

Plans, specifications and estimates for the freeway are complete for that portion of the route northerly of the Fresno-Merced county line to U.S. 50 west of Tracy, and design work is in various stages of completion for all remaining portions of the route. As the freeway is part of the National System of Interstate and Defense Highways, construction of it must be completed by 1972. Construction of the aqueduct between the Delta and the Tehachapi Mountains is scheduled for completion by late 1970.

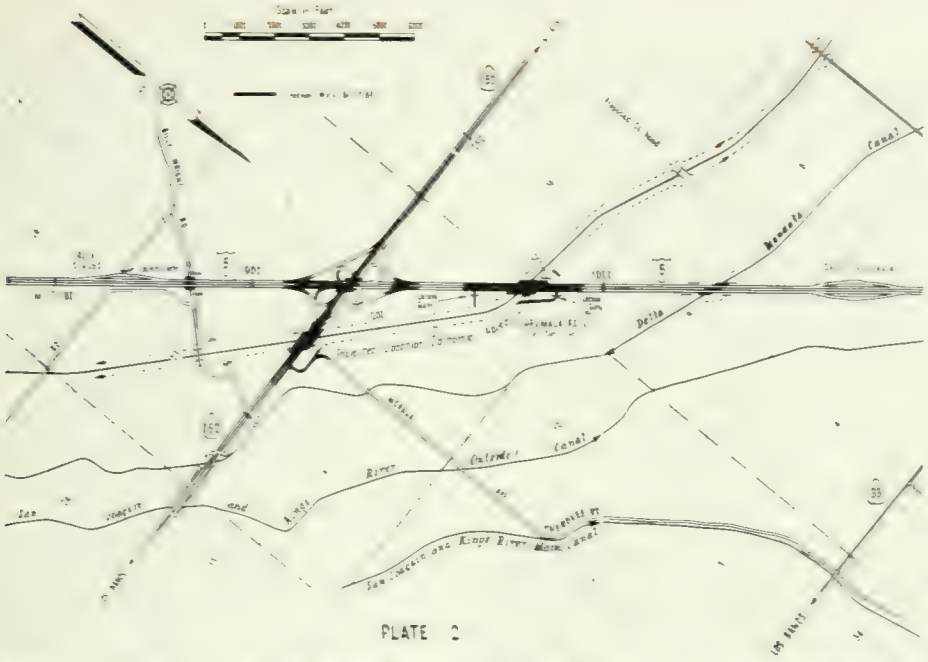
Where the freeway and the aqueduct must cross or be closely adjacent, as typified by the area shown in Photograph 1, close co-ordination between the designing agencies was necessary to achieve mutually satisfactory designs with the maximum savings in time and money. Excellent detail co-operation prevailed throughout between the Division of Highways and both the Department of Water Resources and the U.S. Bureau of Reclamation.

In Photograph 1, as in all photographs accompanying this article, the separate roadbeds of the freeway are shown solid and the aqueuduct alignment is shown as dashed. Some idea of the projected aqueduct size can be obtained by comparing it to the Delta-Mendota Canal in Photograph 1. In this area westerly of Patterson the aqueduct is to carry approximately 2½ times the quantity of water which the Delta-Mendota Canal is capable of carrying.

While the need for co-ordinating cross drainage structure designs is evident in Photograph 1, other design features requiring co-ordination are not so obvious. For example, the cross road in the foreground is an important county road which must be interchanged with the freeway. This road must be raised to cross the aqueduct yet pass under the freeway in a manner permitting the construction of safe interchange ramps. Complicating this design problem are five large intrastate pipelines which parallel the



PHOTOGRAPH 1. In this aerial west of Patterson in Stanislaus County location of the freeway route is shown by the superimposed double solid line and the proposed aqueduct by the single dashed line.



A design map showing location of the Interstate 5-Sign Route 152 interchange in relation to the California Aqueduct.

freeway-aqueduct through this area and the major cross drainage channel of Black Gulch which parallels the county road.

Joint Financing

The joint construction features in this area will be done as part of the freeway's construction as it will precede construction of the aqueduct in this area. Financing of joint work, of course, will be by both agencies under terms of an agreement drawn beforehand.

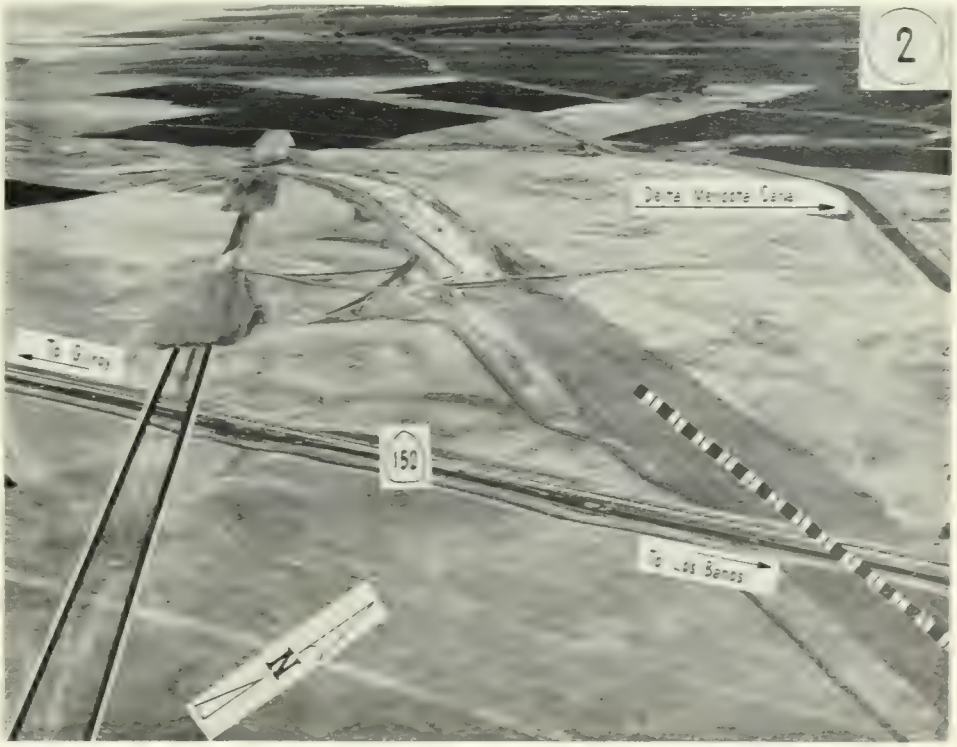
As the Division of Highways was first to perform its detailed survey work through the Westside area, all of its survey control data, section corner ties and related survey and map information were supplied early to the water agencies to assist them in fixing their survey work to the same survey base. Co-ordination at this stage greatly simplified subsequent design co-ordination which included designs of mutually satisfactory alignments, grades, drainage, crossroads, geometrics, earthwork, right-of-way maps and right-of-way deeds.

As many land ownerships are being crossed by both the freeway and the aqueduct, it early became evident that rights-of-way for both facilities should be acquired as one transaction by one state agency where both facilities were under state jurisdiction. From this beginning came an agreement whereby the Division of Highways has been made responsible for the acquisition of all rights-of-way required by the Department of Water Resources.

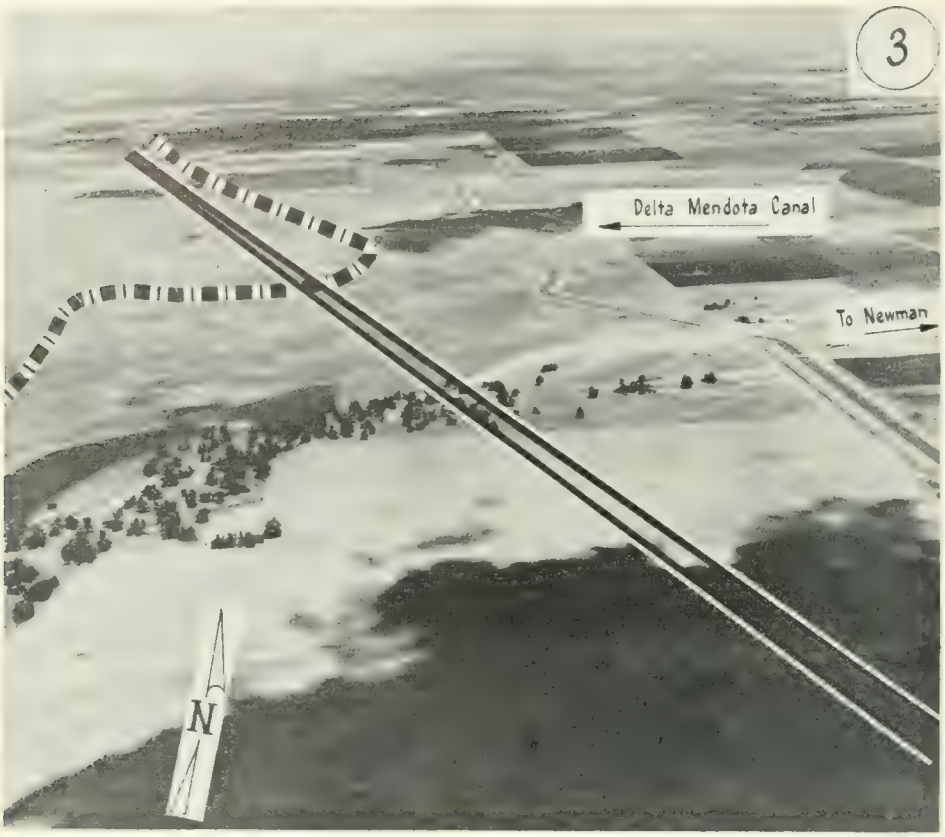
An example of how close interagency co-operation has borne fruit in construction is where the freeway must interchange with the Pacheco Pass Highway, State Sign Route 152, westerly of the City of Los Banos in the San Luis area. Here two freeways must interchange in an area where the U.S. Bureau of Reclamation desired to locate a portion of the aqueduct. The excellent co-operation between representatives of the Division of Highways and the Bureau of Reclamation not only resolved the problem of locating the respective facilities so as to eliminate location conflicts, but also provided the groundwork by which it became possible to incorporate considerable state highway work into the aqueduct construction contract covering this area.

Aqueduct Construction

The construction contract for that portion of the aqueduct between San Luis and 18 miles southerly thereof was awarded by the U.S. Bureau of Reclamation to Guy F. Atkinson Company on April 29, 1963. Included in this aqueduct construction contract is approximately $1,500,000 worth of freeway work on Interstate 5 and Sign Route 152, approximately two-



PHOTOGRAPH 2. An aerial of part of the area shown in the above map with the aqueduct indicated by the dashed line and the freeway by the double solid line.



PHOTOGRAPH 3. At this location just north of Orestimba Creek in Stanislaus County the aqueduct (dashed line) must pass under the freeway (solid double line). Aqueduct excavation will furnish borrow material for construction of the freeway.

thirds of which is to be done at Division of Highways' expense. This work on the two state highways is indicated on Plate 2 and consists essentially of:

(1) Constructing some 570,000 cubic yards of roadway embankments using all economically available excess excavation material from canal construction.

(2) Constructing all work necessary on State Sign Route 152 through the future interchange so that only one construction interference with traffic will be necessary.

(3) Constructing bridges over the aqueduct for both the Westside Freeway and Sign Route 152.

It is estimated that this construction co-ordination will result in a savings of approximately $500,000 to the public agencies involved.

The Atkinson Company started work on this construction on June 27, 1963. Photograph 2 shows the construction activity under way in this area on September 3, 1963. In this area the California Aqueduct will carry approximately four times the quantity of water that the Delta-Mendota Canal is capable of carrying.

Aqueduct Furnishes Borrow

Similar construction co-operation is to be undertaken at other locations. Where freeway construction requiring borrow material will precede aqueduct construction and the aqueduct is close enough, the required borrow material will be obtained by excavating the aqueduct as part of the Division of Highways' construction contract. Construction co-operation also will be undertaken at the other places where the aqueduct and the freeway must cross.

One such instance is shown on Photograph 3 where the aqueduct must pass under the freeway just northerly of Orestimba Creek in Stanislaus County. In this case, present construction scheduling has aqueduct construction underway first with freeway construction to follow within a year or two but before the aqueduct must carry water.

At this crossing the Department of Water Resources will delay lining a short segment of the aqueduct so the Division of Highways can construct the necessary bridges with a minimum of difficulty. Placement of aqueduct lining in the crossing area will be made a part of the Division of Highways construction contract.

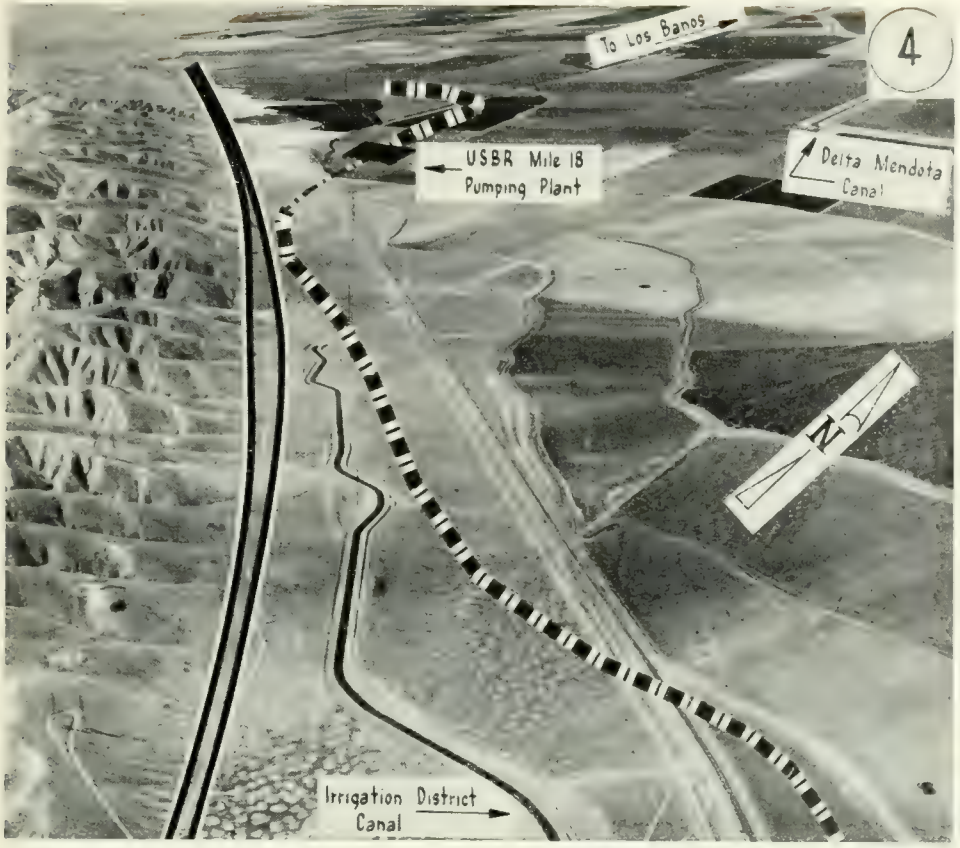
Orestimba Creek flows through the center of Photograph 3 where the trees are evident. This area is one of the most promising for the development of a wayside park by the California Department of Parks and Recreation. That department was granted authority for such parks along the Westside Freeway by the Westside Freeway Park and Development Act which was passed by the Legislature and signed by Governor Brown on July 17, 1963.

Wayside Parks

Wayside parks are located off the freeway and will have access to the freeway via interchanges. Wayside parks, where overnight and picnicking facilities will be available, should not be confused with safety rest areas which are parking and rest areas which will be located within the freeway's right-of-way but clear of the traveled ways.

Between Wheeler Ridge and Tracy six pairs of safety rest areas will be constructed. Each pair will be located at about one-half hour driving intervals at locations which have been approved by the U.S. Bureau of Public Roads. Under authority of the abovementioned Westside Freeway Park and Recreational Act, the Division of Highways will install restroom facilities, tables, refuse containers, shade trees or shade structures and other related noncommercial facilities for the traveling public at these six locations. These service facilities will be in addition to the on and off access roads and parking areas usually constructed by the Division of Highways under authority granted to it by the federal government for the construction of safety rest areas on the Interstate Highway System.

In addition to the above six pairs of safety rest areas, two vista points will be constructed in Stanislaus County, one northbound and one southbound.



PHOTOGRAPH 4. North of the Fresno-Merced county line the freeway (solid double line) will be located along the edge of the Coast Range foothills.

These vista points will be located atop knolls adjacent to the freeway where the interested public can obtain outstanding views of the Central Valley, the foothills, the California Aqueduct and the Delta-Mendota Canal. At these locations, parking areas connecting to the freeway via offramps and onramps will be provided.

Scenic Values

Northerly from the Fresno-Merced county line, the freeway is located generally along the toe of the Coast Range foothills within a narrow belt which is above the westerly extent of irrigable lands. As a consequence of its elevation and location, the drive along the Westside Freeway through Merced, Stanislaus and San Joaquin Counties where the California Aqueduct is adjacent should prove enjoyable from a scenic standpoint as changing vistas of the vast farmlands to the east and the Coast Range to the west will be obtained.

Photograph 4 is illustrative of the location above described and also shows a section of freeway where independent roadway alignments and grades have been combined to achieve a pleasing effect. In this instance, the freeway steps up the foothills to clear the outlet channel of the U.S. Bureau of Reclamation's Mile 18 pumping plant southerly of Los Banos. The difference in elevation between the northbound and southbound roadways in this area reaches approximately 70 feet.

Between Kettleman City and Tracy five sections of independent alignments have been designed to obtain an aesthetic and pleasing appearance. Independent gradelines of the two roadbeds are to be used throughout, being more exaggerated in the areas of independent alignment.

Three Contracts to Be Awarded

Three contracts are to be awarded this coming year for approximately 20 miles of construction along the freeway. Construction on an additional 72 miles is scheduled for the year which follows. A high rate of contract construction will continue through the 1970-71 fiscal year so as to complete the entire freeway by 1972.

Although some local traffic service will be rendered by those portions of the route completed prior to 1972, the freeway's full benefit to California's motoring public will not be realized until it can be opened to through traffic. An example of these benefits is the 22-mile distance savings the freeway will provide Bay area-Southern California traffic over the shortest existing route now serving this traffic.

New freeway construction of the length and magnitude of California's Westside Freeway is indeed unique. As this freeway generally parallels major aqueduct construction for much of its length, an unusual amount of close detail co-ordination was required between the Division of Highways and those agencies responsible for aqueduct construction—the California Department of Water Resources and the U.S. Bureau of Reclamation. This freeway-aqueduct co-ordination is now beginning to bear fruit in construction and was, of course, in addition to much necessary co-ordination with many other federal, state and local agencies.

District IV Loses Materials Expert

Edgar R. Hoffman, Associate Highway Engineer for the Division of Highways Materials and Research Department in the Berkeley Branch Office, has retired after a career of 35 years with the State.



EDGAR R. HOFFMAN

Hoffman was born near Keystone, South Dakota. A graduate of the University of California at Berkeley, he joined the division in 1928 as an assistant resident engineer.

At the time of his retirement he headed a staff engaged in the inspection and testing of highway construction materials prior to their shipment to state highway jobsites.

Hoffman is married and has a daughter.

Employee Safety

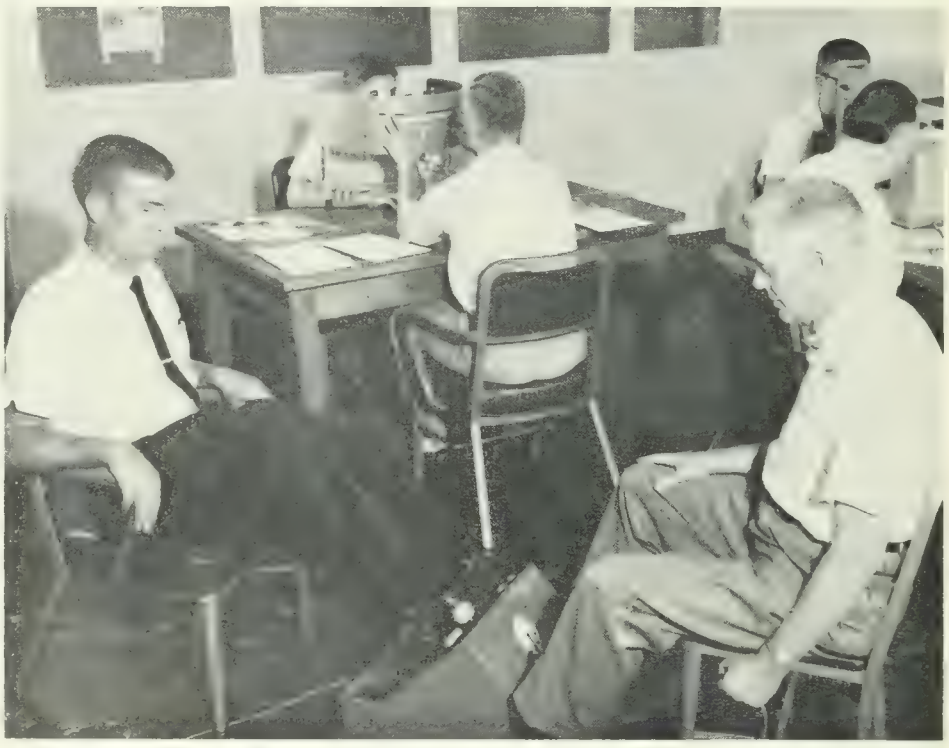
Twenty-five-year Effort Brings Outstanding Results

By B. A. SWITZER, Division Safety Engineer

Safety as an independent function in the Division of Highways was recognized when an administrative order creating a Traffic Safety Department was issued March 1, 1938.

The new department was instructed to make traffic studies, review traffic accident reports, make recommendations for traffic control devices, promote traffic safety and review compensation accident reports, inspect buildings and plants and take action or make recommendations to improve our employee accident record. Traffic engineers were appointed in all the districts with these responsibilities.

In June of 1940 the State Highway Engineer, in a circular letter to the district engineers, emphasized the importance of an active program to prevent employee accidents. He called attention to the high cost of compensation and advised them that our accident frequency rate was three times higher than the general industrial rate. He added that not only had there been no improvement in the past eight years, but it had actually become worse.



Psychophysical tests in connection with the driver training program underway in District VII (Los Angeles). In the foreground is an electrical device for clocking braking reaction time; top center, testing for angle or side vision; right, testing for depth perception. The latter instrument is also used to determine visual acuity.

Information Inadequate

It was soon evident that the factual information on the compensation forms was not adequate for a satisfactory safety program. On January 1, 1941, a new form was added to those to be submitted on injury cases. The front of this form was identical to the compensation form and on the back was a number of analytical questions to be answered by the supervisor. These questions were calculated to encourage the supervisor to analyze and determine the cause of the accident and put into effect or recommend to higher authority appropriate action to prevent a recurrence.

In March of 1943, diminishing manpower resulting from our war effort impelled the State Highway Engineer to again circularize the district engineers and department heads to conserve manpower through accident prevention. Our accident frequency rate for 1942 was 50.89 and was especially a reason for concern when manpower was so scarce.

Governor Warren, in December of 1949, called on state department heads to establish safety committees and take all reasonable steps for prevention of state-owned vehicle accidents. The following May the Director of Public Works instructed his division heads to activate an all-inclusive safety program.

The Division of Highways the following July (1950) named full-time safety supervisors to each of its 11 districts and part-time safety supervisors to each of five major headquarters departments. The safety section was established in headquarters and administrative procedures were developed. The headquarters office of the safety section is composed of the safety engineer and two assistants with a small staff to co-ordinate the program and collect and analyze accident statistics.

District Committees

In each district there is a safety committee to review accidents and recommend accident prevention procedures. The committee is composed of the district maintenance engineer, the superintendent of the equipment department shop and such other district department heads as the district engineer considers appropriate. The district safety supervisor acts as secretary to the committee and in most cases reports to the Assistant District Engineer—Administration.

The members of the district safety committee are expected to be at sufficiently high levels of authority to en-

able them to take immediate and effective action on safety proposals that affect the welfare of the employees of their departments. Since the safety supervisor must work across all channels of line supervision, it has been found most satisfactory for him to report to a high level of administrative authority.

The duties of the safety supervisors have been established as follows:

1. Serve as secretary to the district (or bridge department, laboratory, etc.) safety committee.
2. Maintain records and prepare statistical reports for headquarters safety section and the division safety committee.
3. Do the necessary preliminary work and carry out the details of functions assigned to the district safety committee as outlined below.

The district safety committee:

A. Examines and reviews all accident reports. This includes reports of automobile accidents (Form 270); and reports of industrial injuries (Form 67);

B. Ascertains that all material facts are contained in the reports;

C. Decides the basic cause of each accident and recordability; decisions to be based on whether or not the state operator or employee exercised prudent and careful judgment in his attempt to avoid the accident;

D. Interviews the state operator or employee who has been involved in an accident in all instances where such action is deemed advisable;

E. Advises the state operator or employee of the committee's decision concerning the recordability and the cause for each accident examined and reviewed by the committee (this should be in writing);

F. Makes such recommendations to the district engineer, or through him to the division, as the committee deems appropriate;

G. Recommends disciplinary action to the district engineer when in the judgment of the committee such action is justified in the light of all the circumstances;

H. Holds regular meetings at least once each month;

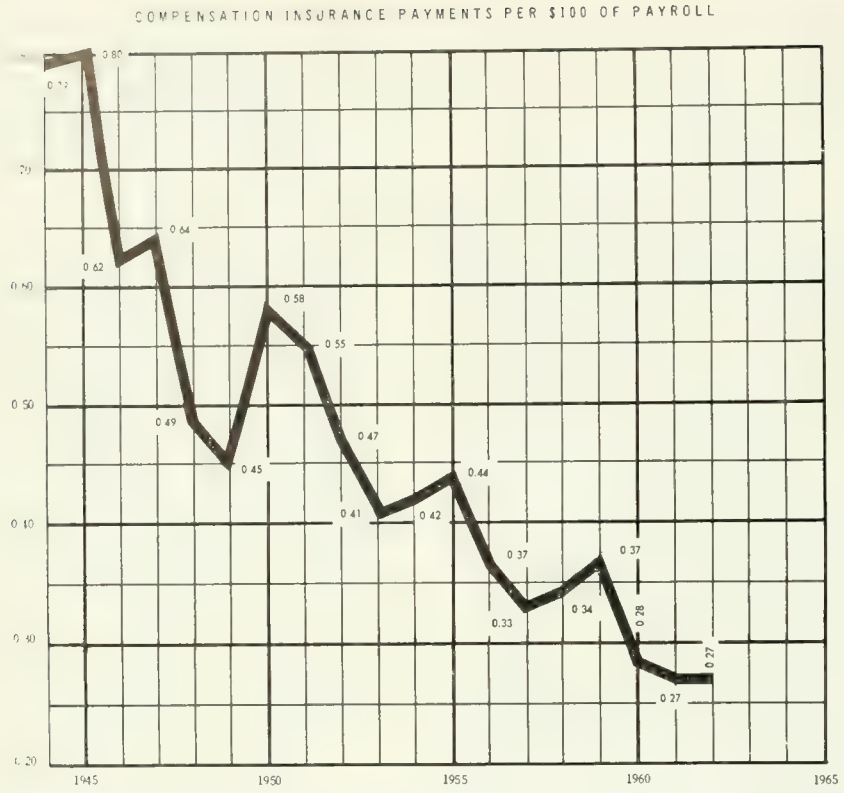
I. Carries out an education program to acquaint district employees with safe practices, the safety code, motor vehicle laws, hazardous operations, accident causes, and the district safety program. Safety literature, posters, bulletins should be considered as safety tools;

J. Reports committee activities for the preceding month to division safety engineer on or before the 15th of each month.

In order to provide for consistencies of operation and develop a community of interest, each district is required to submit minutes of their



Safety Engineer B. A. Switzer discusses a guide system in control of traffic around a typical working area with surveyors, engineers and maintenance supervisors at a class on work area protection.



monthly meetings to headquarters with meetings being held early enough so that the minutes can be prepared and be in Sacramento prior to the 19th of the month.

The minutes from these meetings are condensed into an interim report, which is forwarded to the division safety committee five days in advance of its meeting. The division or headquarters committee meeting is usually held the first or second Friday of the month following the meeting of the district committees.

The division committee is composed of the Deputy State Highway Engineer—Administration as chairman, with the equipment engineer, the maintenance engineer, the engineer in charge of personnel and public information and an attorney as regular members of the committee. The safety engineer acts as secretary.

The division safety committee responsibilities are:

A. To formulate the details of the program within the framework of which the district committees shall operate;

B. To review the monthly reports of the district committees and advise with the district committees on problems presented;

C. To review and make recommendations with respect to the more difficult problems which may be referred to it by the district committees;

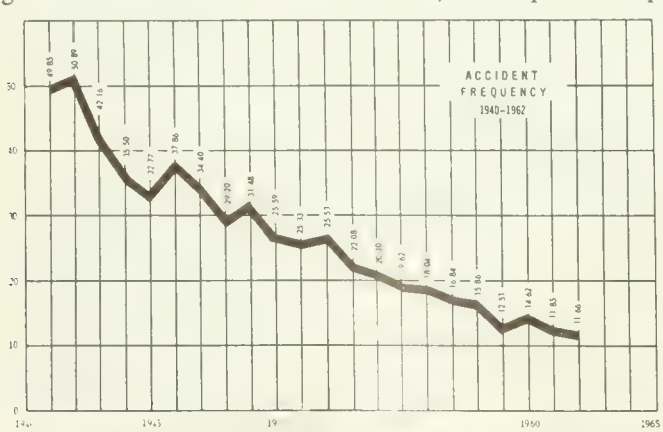
D. Act as a clearinghouse for ideas and suggestions which may be incorporated into the program;

E. Perform the same duties with respect to accidents involving headquarters personnel which are delegated to district committees;

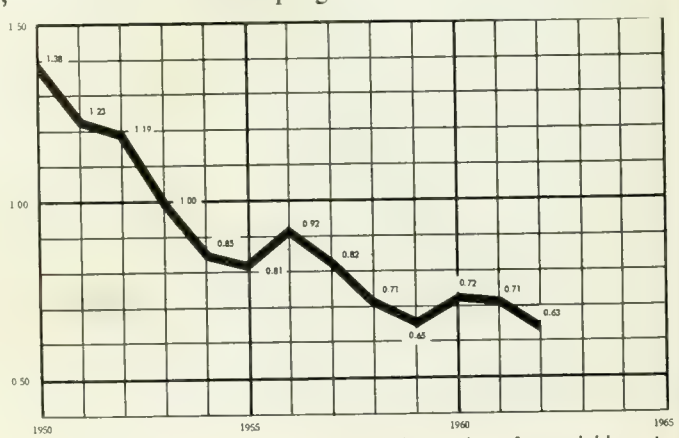
F. Review from time to time the effectiveness of the program as carried out by the various districts and report thereon to the division head. The division head shall in turn report quarterly to the director.

The interim report (in the hands of the committee) is reviewed in detail and the district action may be supplemented by headquarters action to make it more effective. A month-by-month statistical report, which is a part of the interim report, is reviewed to determine the effectiveness of the program. Consideration is given to those areas which require special attention. Detailed reports are requested when more information is considered necessary to enable the committee to prepare recommendations on important measures.

Minutes of the headquarters committees are prepared, and the interim report, together with the minutes, is sent to each district and major department. This provides each district with complete information on the safety program throughout the State and has been found to be a valuable tool in the program.



The above chart shows the marked improvement in the number of lost-time injuries per million man-hours of exposure from 1941 to date.



The above chart shows the improvement in the number of recordable motor vehicle accidents per million miles of travel from 1950 to date.

The safety section develops specialized safety material and promotes meetings and discussions to point out hazards that need to be recognized for developing and using safe procedures.

When Governor Brown, in a directive dated December 16, 1959, required all state agencies to conduct a driver training and vehicle accident prevention program, the responsibilities for developing and conducting the course in the Department of Public Works was assigned to the safety section.

Defensive Driving Course

While a suggested course was made available by the State Safety Co-ordinator, it was determined to develop a defensive driving course appropriate to our particular personnel needs. The course consisted of three hours of classroom work, a psychophysical test and a road observation run.

Approximately two hours of the classroom portion of the course was composed of a lecture and moving pictures on "defensive driving" techniques. The remaining hour was used for classroom discussion with audience participation.

The lecture was pointed toward methods and procedures that have proved effective in defensive driving. The psychophysical tests were designed to indicate to the employee any defective physical condition that might affect his driving and for which he should compensate. It consisted of tests for visual acuity, color blindness, depth perception, width of vision and reaction time. The road observation run was designed to observe the driver's driving habits that could result in his becoming involved in an accident.

By January 31, 1961, the first series of defensive driving courses had been given to 13,580 employees. This is a continuing course with lectures, psychophysical and road evaluation tests given in the districts and headquarters every three months. Since this first series was completed we have given the course to an additional 2,315 employees. Since supervisors are responsible for assignment of driving duties to employees, the responsibility for giving the road observation run to new employees, before assignment of



G T. McCoy, former State Highway Engineer, presents J. G. Meyer, District Engineer in charge of District X (Stockton), with a certificate of achievement for best accident prevention in 1956. This was the first such certificate awarded for an accident prevention record in the Division of Highways.



PHOTO ABOVE. Deputy State Highway Engineer C. E. Waite (right), who has recently retired, presents to Alan S. Hart, Assistant State Highway Engineer for District III (Marysville), the certificate of achievement for 1962 for best accident prevention record in the division for that year. PHOTO BELOW. C. G. Beer, then Assistant District Engineer for District VIII (San Bernardino) and now urban planner for the division in Sacramento, receives from Safety Engineer B. A. Switzer a plaque commemorating a million accident-free hours in the district. H. N. Lienau, Safety Supervisor in District VIII, is on the right. District III (Marysville) received a similar plaque a few months later.



driving duties, is being delegated to the supervisors.

Inherent Hazards Emphasized

The safety program is based on the principle that safety is an integral part of proper work procedures. Meetings of operational personnel are encouraged monthly or more frequently according to operational conditions. Emphasis is placed on inherent hazards. Safety supervisors frequently address such meetings, but the foremen, superintendents, or resident engineers usually act as the chairmen and promote the discussions.

While no monetary awards are authorized to state employees, safety records and achievements are recognized. Men with no accident records for two years or more are presented wallet cards; superintendents and foremen whose crews work a year or more without lost-time accidents are presented certificates, and each year the district with the best accident frequency record is presented a special certificate of achievement with appropriate ceremonies. For the past two years this has been won by District III. In 1962 Districts III and VIII each achieved a million man-hours without a lost-time accident. Special plaques were designed and presented for this accomplishment.

The safety section does not issue a safety manual. Appropriate safety instructions for various operating conditions are covered in operating manuals. Pamphlets and posters are issued by the safety section when work methods or procedures need added emphasis.

Accident Reports Analyzed

Before being referred to the district safety committee, accident reports are carefully reviewed and analyzed in the districts by the foreman or supervisor of the injured employee. He must answer a series of questions on the back of the accident form designed to help him to analyze the accident, determine its cause, and take appropriate action toward prevention of its recurrence. No accident is studied or reviewed with the intent of placing blame on the employee. An approach of this kind is not appropriate to our safety procedures.

Motor vehicle accidents are reviewed by the district or department safety committee and are divided into three classes:

Class I—An accident in which the state vehicle is not directly involved, but, because of its position, may have contributed toward the accident.

Class II—Accidents resulting from work operations and incidental to operating procedures.

Class III—Those accidents not included in the Class I or Class II. They are further divided into recordable accidents or nonrecordable accidents. A recordable accident is one which could have been prevented by more defensive driving on the part of the state driver. The legal rights and privileges are not determining factors in establishing recordability.

Class III accidents are analyzed by the district safety committee to determine if they are recordable or nonrecordable and to determine appropriate action to prevent their recurrence. Vehicle drivers are frequently requested to appear before the committee to explain the details of the accident and the conditions that prevented the driver's avoiding it. If the committee finds an employee driver does not practice defensive driving and has a record of recordable accidents or citations for moving violations it may recommend counseling by the safety supervisor or disciplinary action by the district engineer.

Problem Areas Determined

The safety engineer and his staff review accident statistics and records to determine trends and problem areas. Such a problem was recently isolated in operation of rotary mowers. In addition to our own records, all of the other states were re-



This high standard with its pattern of three flags can be seen over the top of the average car. Here, it is being used as a support for a 48-inch federal standard sign. The sign is made of nylon material and can be dismantled and transported in rolled condition.



A high-level warning device with flashing lights protects an inspector making compaction tests. Compaction tests are made around the clock, requiring an inspector to make tests at night with contractor's equipment moving around him.

quested to furnish their records and experience. As a result of this investigation special guards were designed and installed on all rotary mowers in the division. Experience with this guarding is being recorded and operating departments are experimenting with other methods and equipment for weed control in an effort to eliminate all possible hazards to passing traffic.

Rear-end accidents to slow-moving equipment such as snowplows, sweepers, etc., are also found to be a special problem. Working with operating departments, alternate flashing amber lights facing the rear have been tried out and appear to be effective.

The inherent hazards of working on the highway under modern traffic conditions have encouraged the safety section to develop a special course of training on this subject.

The course describes how lanes on high-speed multilane facilities can be closed with a minimum of inconvenience to traffic when adequate advanced warning is provided and a well-designed guide system is established. Under such conditions high level warning is essential. Indeed, such warning is desirable in connection with work protection on all types of roads.

The course also shows that when it is necessary to close a traffic lane on a multilane facility, a speed restriction should be avoided, as the slowing of traffic in the restricted area develops congestion and increases the hazards.

Frequency Rate

The effectiveness of a safety program in employee accident prevention is measured by a "frequency rate" which is the ratio of the number of lost-time injuries per million man-hours of exposure and a "severity rate," which is the number of days lost per million man-hours of exposure.

Motor vehicle accident experience is measured by the number of recordable accidents per million miles of travel. To show a cost relationship to accidents we have developed a chart showing the compensation insurance cost per $100 of payroll. Charts showing the division record are included in this article.

The district office buildings, maintenance buildings, and other facilities are protected against fire by standard firefighting equipment, including fire extinguishers. Control of small fires by fire extinguishers is an important part of plant protection.

The most effective use of fire extinguishers can be made by employees who are experienced in the use of the extinguishers. It is, therefore, the practice in the division to have fire control demonstrations at various maintenance stations; particularly those in remote areas which must frequently depend on their own fire protection equipment or facilities. In such demonstrations, each employee is encouraged to actually handle an extinguisher and extinguish a control fire.

Fire Extinguishers Checked

During a fire demonstration a few years ago an extinguisher failed to function and was thrown into a vacant lot where it exploded. This experience prompted the division to make an immediate inspection of all of its extinguishers. Test equipment was purchased and all extinguishers subject to high pressures were hydrostatically tested under control conditions. Inspections and tests of the extinguishers showed that there were a number of antiquated units still assigned to important points of fire protection. As a result of this program, between 15 and 20 percent of the extinguishers were replaced with more modern equipment. A regular program is now underway to test pressurized equipment every five years.

Equipment with separate pressurized units, such as gas cartridges, is referred to the manufacturer when inspection shows dents or other damage.

Berkeley Will Host 1964 Road Conference

The annual California Street and Highway Conference for 1964 will be held on the Berkeley campus of the University of California. The dates have been announced for January 30 and 31 and February 1.

The conference, which brings together state, city and county engineers and others interested in transportation, is organized by the university's Institute of Transportation and Traffic Engineering.

John Stanford Named To New Department

Governor Edmund G. Brown has appointed John H. Stanford, 44, Assistant Director of the Department of Public Works, to be one of two deputy directors of the new Department of General Services.

"John Stanford is a veteran of 17 years of state service," the Governor said. "His responsibilties will include real property and facilities requirements and the office of the State Architect, responsibilities which he is remarkably well qualified to discharge."



JOHN STANFORD

Stanford, a native of Urbana, Illinois, attended the University of California at Berkeley, where he received a bachelor of arts degree in political science with highest honors. He was a member of Phi Beta Kappa there. He received his master of arts degree in public administration from Syracuse University's Maxwell Graduate School.

He is past president of the Sacramento Chapter of the American Society for Public Administration, a member of the Western Governmental Research Association and the Commonwealth Club.

He began his state service with the Department of Finance and worked for the Department of Insurance before coming to the Department of Public Works in 1955.

He served from 1942 to 1946 in the United States Air Force Air Transport Command, entering as a private and leaving as a captain.

He is a part-time instructor in government at Sacramento State College.

He and his wife, the former Betty Bond, have three children.

An express highway interchange is pictured on a commemorative postage stamp recently issued by Japan. Commemorating the opening of the Nagoya-Kobe Expressway, the stamp is reproduced in three color photogravure

DEPARTMENT MARKS RETIREMENT OF 76 EMPLOYEES

District I

Earl H. Rhoten, Laborer, 17 years; Carl W. Judd, Highway Maintenance Man II, 9 years; Hugh B. Geoghegan, Bridge Maintenance Foreman, 30 years; James Henderson, Associate Right-of-Way Agent, 19 years.

District II

Anthony T. Leal, Highway Maintenance Man II, 31 years; Harry I. Overstreet, Heavy Equipment Mechanic, 37 years; Olen J. Hampton, Highway Maintenance Man II, 18 years.

District III

John R. Christian, Highway Field Office Assistant, 12 years; J. Harold Couk, Office Building Engineer, 13 years; Benjamin F. McDonald, Highway Maintenance Man I, 16 years; William R. Havill, Highway Foreman, 36 years; Eldon C. Patchell, Supervising Cook I, 25 years; Gordon W. Wooden, Assistant Highway Engineer, 17 years; Paul B. Clark, Carpenter I, 11 years; Harry C. Schultz, Highway Foreman, 37 years; William C. Eden, Highway Field Office Assistant, 40 years; Howard T. Bigelow, Highway Superintendent, 43 years.

District IV

Peter J. Meyer, Lead Groundsman, 11 years; Leroy C. Gaberel, Senior Highway Engineer, 33 years; Ruby R. Cook, Senior Stenographer, 21 years; Rolla C. Puzey, Assistant Highway Engineer, 33 years; John R. Hawes, Assistant Highway Engineer, 13 years; Max J. Paul, Assistant Highway Engineer, 34 years; James A. Spence, Supervising Highway Engineer, 34 years; Carl H. Johnson, Electrician I, 26 years.

District V

Dewey L. Barrick, Highway Foreman, 33 years; Percy O. James, Highway Foreman, 37 years; Clarence E. Blinn, Highway Maintenance Man II, 28 years; Henry S. Aldrich, Assistant Highway Engineer, 16 years.

District VI

Lyle Stanley, Highway Superintendent, 30 years; George F. Anderson, Highway Foreman, 33 years.

District VII

Roman H. Brumm, Associate Highway Engineer, 15 years; James B. Griffin, Highway Foreman, 28 years; Edgar Bushman, Drafting Aid II, 7 years; Carl C. Nelson, Highway Foreman, 37 years; Edward Love, Janitor Foreman I, 22 years; Van D. Robinson, Highway Bridge Maintenance Foreman, 31 years; Albert E. Thorman, Highway Foreman, 30 years; Blodwen Holman, Senior Clerk, 10 years; Gilbert K. Clark, Senior Right-of-Way Agent, 19 years; William P. Devine, Assistant Highway Engineer, 42 years; Lee R. Potter, Highway Foreman, 31 years; Wayne M. Blotter, Highway Engineer Associate, 45 years; Esther M. Armstrong, Senior Account Clerk, 14 years.

District VIII

William L. Comerford, Janitor, 34 years.

District IX

Henry R. Scott, Highway Foreman, 28 years; Frank B. Thrailkill, Highway Maintenance Man I, 27 years.

District X

Earl L. Highley, Drawbridge Operator, 26 years; Anthony Angerina, Highway Foreman, 42 years; Lester W. Young, Highway Maintenance Man III, 33 years; Paul V. Craig, Drawbridge Operator, 20 years.

District XI

Leo G. Cline, Assistant Highway Engineer, 37 years; Alameda K. Wheeler, Account Technician III, 36 years.

Headquarters Office

Luther L. Funk, Principal Highway Engineer, 33 years; Matthew Freder-

. . . Continued on page 63

Modesto Project

6-Lane Freeway Will Form Nucleus of Future System

By J. G. MEYER, District Engineer



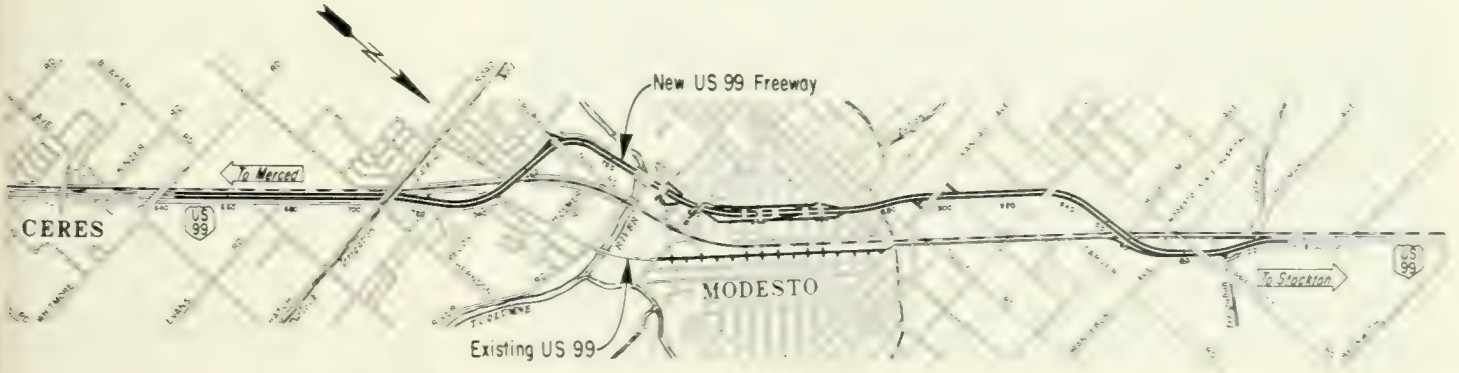
The message on the illuminated metal arch, "Modesto—Water, Wealth, Contentment, Health," tells the story of this progressive community to the present generation of Highway 99 motorists just as it did to travelers of 50 years ago. Traditionally the focal point of agricultural operations in Stanislaus County, one of the more productive agricultural counties in the nation, Modesto is also an important industrial and transportation center and is growing in population at twice the rate of the State as a whole.

To keep pace with the rapid traffic expansion generated by this growth, the Division of Highways has freeway construction on U.S. 99 in progress through the greater Modesto area. This six-lane freeway will be the nucleus of a network of state highways still in the planning stage, which will comprise the California freeway and expressway system in the area. The other routes of this network are Sign Route 132 extending from Interstate Route 5 south of Tracy to the Mother Lode, and Sign Route 108 extending from Interstate Route 5 near Crows Landing to Sonora Pass and the easterly side of the Sierra.



Hatch Road overcrossing looking east. The interchange is not complete at this stage.

Construction work on U.S. 99 freeway is now more than half completed. The full significance of the seven-mile-long project may not be apparent to the casual glance of the motorist, because four miles are on new alignment to the west of the existing highway. The through driver does, however, get some encouragement from the noticeable construction activity visible at the ends of the project, as he is delayed by the heavy traffic



A map of the Modesto area showing the limits of the new freeway project.



An aerial of the existing bridges across the Tuolumne River with the twin freeway spans under construction in the foreground.

passing through the series of intersections, traffic signals, and railroad crossings on the present highway. Occasional train movements along the Tidewater Southern railroad tracks running down the center of the highway add to the difficulties and hazards of driving through Modesto. The motorist, however, can look forward to traveling through this city in 1965 at freeway speeds with a feeling of safety now enjoyed by other motorists traveling on portions of California freeway system already completed.

Planning

The initial planning for this project began in 1952, with route studies for a freeway alignment which would supersede the existing U.S. 99 that passes along the business district. At that time, the highway was carrying an average of approximately 20,000 vehicles a day and had a four-lane divided section north of the city, four lanes plus a left-turn lane through the most heavily developed area, and three lanes to the south. Summer peak traffic was approximately twice the average traffic and additional lane capacity had to be provided on the three-lane section. Freeway construction was too far in the future to give necessary relief; therefore, in 1955, U.S. 99 between Hatch Road and the Tuolumne River was widened to a four-lane divided highway, and a fourth lane was added to the Tuolumne River bridge.

The freeway route was the subject of exhaustive studies by the Division of Highways, local governmental organizations, and civic groups. All the pertinent information gathered in these studies was presented to the California Highway Commission at a formal hearing in Modesto, and the commission in 1954 adopted a freeway route which crossed to the westerly side of the Southern Pacific railroad and passed through the developed area of the city between Fifth and Sixth Streets. The city agreed to the use of these as one-way streets, and the freeway was designed so that Fifth and Sixth Streets will collect and distribute traffic in conjunction with the freeway ramps.

The new freeway alignment is separated from the existing highway and the principal business district of Modesto by several city streets and two railroads. The Division of Highways and city are working toward developing a couplet of major streets, which would operate initially as part of the city's system of one-way surface streets, but would ultimately cross the railroads and existing highway by means of underpasses. This couplet will strengthen the ties between the freeway and the central business district and the other state highways in the Modesto area.

Design

Design of the freeway began shortly after the adoption of the route and extended over a nine-year period. For purposes of design and construction, the overall project is divided into three separate phases, each corresponding to a construction contract. The first contract for construction of a frontage road between the city limits of Ceres and Hatch Road and a portion of the Hatch Road interchange was completed in 1962. The second contract for grading and structures throughout the Modesto area is now nearing completion, and a third contract for paving and completing the freeway will be advertised in the fall of this year.

The freeway design includes seven traffic interchanges and six additional street separations. The partly completed interchange at Hatch Road is already open to traffic and allows an average of 22,000 vehicles a day on Highway 99 to cross under this major east-west county road without interruption. This interchange replaces a former signalized intersection, which was one of the most serious points of accident concentration in District X. The completed interchange will integrate the freeway, the existing highway, and Hatch Road in an area of limited right-of-way, bounded on one side by the Southern Pacific railroad and by residential development on the other.

The freeway will be constructed initially with six lanes from the City of Ceres to the location of a future interchange in the vicinity of Kansas Avenue, which will become the connection for State Sign Route 132 approaching Modesto from the west. North of that point, four lanes will

be constructed. The project was designed so that two additional lanes may later be added for the entire length of the project.

Much engineering study went into the determining a grade line which would cause the minimum amount of disruption to the local area and still provide sufficient fill material for constructing the various street and railroad separations. The result was the depressing of the freeway below ground level at three locations: one adjacent to the Tuolumne River in the vicinity of Crows Landing Road; another between Fifth and Sixth Streets; and the remaining one in the vicinity of Kansas Avenue. These depressed portions provided sufficient material to balance the embankment requirement and, in addition, yielded the subbase material used on a major part of the project.

The depressed sections are lower than the high-water elevations in the Tuolumne River, therefore, storm runoff from these depressed areas must be pumped. Four pumping plants and an extensive system of concrete pipe storm drains were designed to convey this drainage into the river.

Right-of-way

All of the 475 parcels of land required for this freeway were acquired without a single parcel going to a jury trial. This remarkable record can be attributed largely to the length of lead time between determination of right-of-way requirements and construction. In this instance, the six-year interval allowed normal right-of-way negotiations with the property owners to be concluded successfully.

The project required the co-ordination of details for the relocation of facilities of 10 utility companies, and, although the relocation operations required concurrent work by the utility companies and the contractor at some locations, no serious complications have been encountered to date.

Negotiations were carried on with the Southern Pacific and Tidewater Southern railroads during most of the design period and extended into the construction period. These negotiations led to the construction of three railroad grade separation structures and adjustment or elimination of railroad grade crossings with local streets throughout the project.

Construction

The first contract on the overall project, a joint venture of Fredericksen and Watson and Lew Jones Construction Company, was completed in November 1962 at a cost of approximately $1,200,000. This project eliminated all intersections south of Hatch Road and provided traffic with interim use of the Hatch Road interchange.

A second contract, now in progress, was awarded to Matich Constructors and W. F. Maxwell Company with a bid of approximately $5,300,000. This contract covers grading, drainage structures, bridges, and the paving of local roads and street connections. The depressed sections provide 5,100,000 cubic yards of excavation used primarily for construction of fills at the overhead structures north and south of Modesto where the freeway crosses the Southern Pacific railroad and the bridge approach fills at the Tuolumne River. Some surplus excavation material is also being placed in the embankments required for the future interchange with State Sign Route 132.

One of the most unusual construction problems encountered on the grading contract involved the placing of about 55,000 cubic yards of barium waste tailings. The freeway alignment crossed a barium waste stockpile in an industrial area of Modesto, and extensive studies by the Materials and Research Department were made to determine the suitability of this material for embankment construction. Laboratory tests indicated the material to be satisfactory for deposit in thin layers in the larger fills, even though it contained 60 percent to 90 percent fines and had moisture contents up to 150 percent. In working with the material, the contractor found that in thick layers it would not support the weight of construction equipment, but after much difficulty, he was able to get enough earth cover over the spread out tailings to stabilize the fills.

On a project of this size and complexity, communications were a major problem until radio units were provided for the construction forces. The addition of three mobile units greatly



An aerial of grading operations on the new freeway through Modesto. The bridges are under construction.



Freeway grading and construction on the Kansas Avenue overcrossing.

increased the effectiveness of available engineering personnel.

As the grading and structures contract nears completion this fall, a third contract is being prepared for paving the freeway and opening it to traffic. This last contract will include about $4,000,000 worth of construction work and is expected to be completed early in 1965.

Bridges

The most prominent single feature in all this freeway construction is the impressive pair of freeway bridges across the Tuolumne River, each of which is three lanes wide and 700 feet long. These bridges are of reinforced concrete box girder construction and will cost about $730,000.

Eighteen other structures will separate the freeway traffic from rail and local street traffic.

Magnitude of Project

By the time of completion, the three contracts contributing to this freeway will have totaled approximately $12,000,000 in construction cost. Actual construction operations will have taken over four years. A project of this magnitude can only be designed and constructed by close coordination of effort between the state highway organization and the many individuals and organizations, both public and private, that are affected by the freeway. In the progress of the project from the early planning stages to the opening ceremony, myriad engineering and economic problems had to be resolved, if not to the satisfaction of all concerned in each case, at least to an acceptable compromise. In this regard, it is a pleasure to acknowledge that the Division of Highways received a high degree of co-operation from both the City of Modesto and Stanislaus County, and all can take pride in the accomplishment of the completed freeway.

The individuals in the Division of Highways organization most closely associated with the projects comprising this freeway were District Design Engineers Charles Moffatt, Ken Hatch, and Irwin Rosa; Project Design Engineers George Demetras, Tom Wong, Ed Fujitani, and Walt Curtis; and Resident Engineers Ed Robinson and G. P. O'Dougherty.

Fenton Is Legal Head, Rhyner Named Deputy

Appointment of Harry S. Fenton as Chief of the Division of Contracts and Rights of Way and Emerson W. Rhyner as Deputy Chief has been announced by State Director of Public Works John Erreca.



HARRY FENTON

Fenton had been acting chief since the death of Robert E. Reed in April. Rhyner had been attorney in charge of representing the department on legislation.

A native of Sacramento, Fenton is a graduate of the University of Santa Clara and the San Francisco Law School.

After World War II service in the Air Force, he joined the Department of Public Works legal staff in 1946 as junior counsel. He was appointed assistant chief of the division in 1955.

Fenton is a member of the Elks Lodge and the Native Sons of the Golden West. He also holds membership in the Sierra Club, California Historical Society, Crocker Art Gallery Association and Mount Ralston Fish Planting Club. He is past director of the Sacramento County Historical Society and past president of the Sacramento Book Collectors Club.

Fenton is married and has one son.



EMERSON RHYNER

Rhyner, who was born in Glendora, attended Southwestern University in Los Angeles and received his bachelor of laws degree in 1939.

He served in the U.S. Navy during World War II, entered private law practice in Puente in 1946 and was appointed Deputy City Attorney of Glendale in 1947.

He joined the Division of Contracts and Rights of Way in 1953.

Rhyner is married and has a son and a daughter.

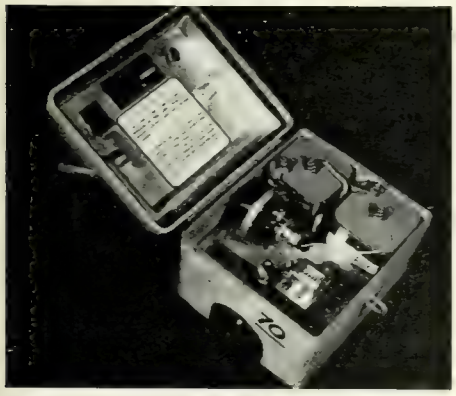
Modernized Counters

Junior Units Take 20,000 One-day Counts Each Year

By C. F. WASSER, JR., Assistant District Traffic Engineer, and
CARROLL E. DUNHAM, Associate Highway Engineer

Three years ago, California's manual traffic counting system was replaced by a mechanical counting program. The planning and organization of the new census program were discussed in "TRAFFIC CENSUS" in the July-August 1962 issue of *California Highways and Public Works*.

As expected, first-year operational difficulties limited program accomplishments. Troubleshooting became the main occupation of traffic census personnel.



One of the unmodified portable ever-accumulating traffic counters. It is powered by two six-volt batteries. The circular piece next to the rear battery is the air diaphragm.

The largest problem was the erratic performance of the small junior traffic counters. These counters were difficult to adjust for both fast- and slow-moving traffic, for heavy and light vehicles, and for various roadway widths. The contact points on these counters tended to burn and/or stick, causing lost counts.

These difficulties did not last long. Experiments conducted in at least three Districts resulted in two successful employee suggestions. Both suggested inexpensive alterations to the electrical circuitry of the counter, improving its operation.

The junior counter improvements have already enjoyed a far-reaching effect by attracting attention of out-of-state and foreign traffic engineers.

Frequent Redesigning Impractical

With the limited market for counters of this type, frequent redesigning and modernization of the equipment is not practical from a manufacturer's viewpoint. The junior counters are produced by a reliable company. Their performance had been satisfactory for our purposes before adoption of the mechanical traffic census program. The mechanized system expanded their use and demanded counting accuracy equal to the punched tape hourly recording counters. (Both the recorders and nonrecorders are used simultaneously when taking route traffic volume profiles.) The junior counters are performing one-half of the field work in California's census program. They produce about 20,000 one-day counts annually.

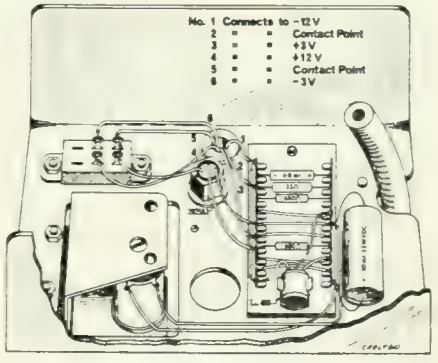
The road - tube - actuated junior counter was designed over 20 years ago. The original models were powered by two 6-volt dry cell batteries connected in parallel as shown on Diagram I. They operate something like this:

An automobile tire passing over a closed end road tube compresses the trapped air, causing defiection of a thin plastic diaphragm at the counter end of the tube. The diaphragm movement forces closure of silver contact points. About 1.2 amperes flow through the contact points and 7.2 watts is delivered to a coil wound about an iron core, producing a magnetic field. The field attracts a steel lever arm that is held away by a steel spring. When the contact points break, opening the circuit, the magnetic field collapses allowing the spring to return the lever arm to its original position. On the way to the reset position, the lever arm kicks a ratchet wheel, causing $\frac{1}{20}$ rotation of the shaft of a simple dial counter. This counts $\frac{1}{2}$ of an automobile.

Inductive Kick Absorbed

The resistor and capacitor network across the coil in Diagram I was designed to absorb the high-voltage inductive kick and minimize contact point arcing upon collapse of the magnetic field.

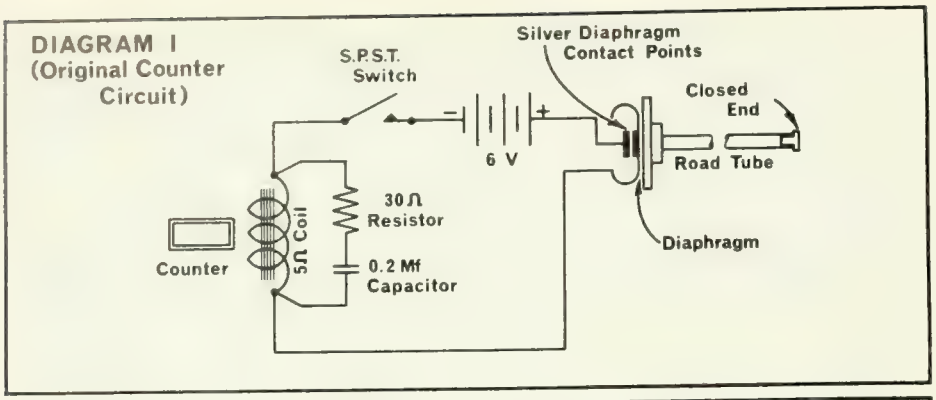
The circuit and mechanical linkage were simple and worked well on low volume, two-lane highways and slow speed, two-lane city streets. A single count cycle required about 40 milliseconds, after which the counter was prepared to receive another call.

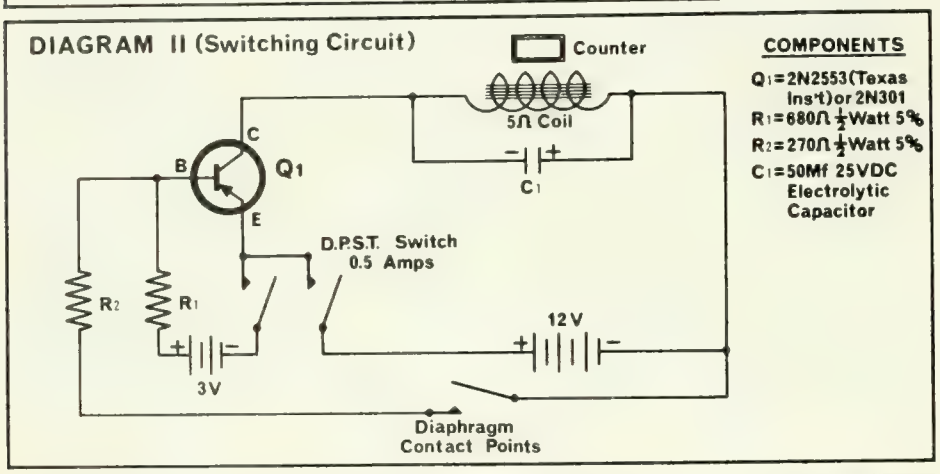


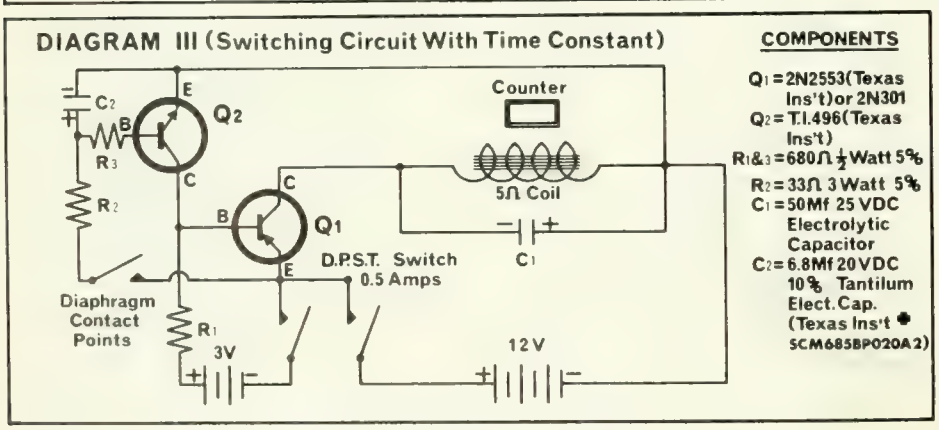
Cutaway section of the junior counter chassis assembly removed from its outer box.

When counting high-speed traffic, the electromagnet did not have the power to fully actuate the lever arm during very short periods of contact closure. When a road tube was stretched across multilane highways, the lever arm spring did not complete the cycle and reset the counter quickly enough to record a close-following air pulse.

Some time later, the manufacturer recommended increasing the strength of the electromagnet and stiffening the return spring. They simply connected







the two 6-volt batteries in series instead of parallel, took advantage of the available 12-volt power supply, and delivered 28.8 watts to the electromagnet. The stronger magnetic field attracted the lever arm faster and the stronger spring hastened the reset action.

It was at this stage the State increased its number of junior counters from 150 to about 500.

Personnel using junior counters soon discovered a major flaw in the electrical circuit. Passing 2.4 amperes through the 2.0 amp silver contact points was not successful. After a few days of field operation, the contact points were badly burned and pitted.

Maintenance costs for cleaning and replacing contact points were prohibitive. Contact gap and air pulse strength adjustments were critical and time-consuming for field personnel. Field data from the counters ranged from marginal to unsatisfactory.

Transistor Switching Circuit

In 1960, an employee suggestion from Cecil Baisley of District X had recommended a transistor switching circuit in the junior counter to reduce the current through the contact points. Little interest had been shown in developing such a circuit until large scale production was required from the counters.

The transistor is a miracle of modern electronics and physics. It not only replaces the vacuum tube in small radios, but can also be used as an ultra-high-speed DC switch or relay. Normally, the device offers extremely high resistance to voltage applied across the emitter-collector electrodes. When a small current passes through the base-emitter junction, the emitter-collector resistance practically disappears, allowing large currents to flow through the emitter-collector circuit like a closed switch. The switching time of transistors is a few microseconds.

A joint effort of Headquarters Materials and Research Department and District XI developed the high-speed switching circuit shown on Diagram II. Less than 50 milliamps through the contact points is required to switch on power transistor Q-1. Approximately 1.7 amperes flow through the collector and coil. Electrolytic capacitor C-1 across the coil with reverse polarity causes rapid collapse of the magnetic field when the transistor is switched off. C-1 also minimizes the inductive kick upon collapse of the coil, protecting the emitter-collector circuit of Q-1 from high voltages exceeding breakdown conditions.

Resistance Drops Rapidly

The emitter-collector resistance of germanium power transistors drops rapidly as the case temperature approaches 100° F. The device then leaks more current than can be tolerated. A small reverse voltage supplied by the three-volt battery compensates for the resistance drop and extends the high ambient temperature capability of the circuit to 170° F. The circuit is designed for cold weather operation to −30° F.

This modification was publicized and made available to the districts in kit form in 1961. About ¾ of all junior counters were converted by district personnel.

The Diagram II switching circuit worked fine under low- and medium-speed traffic conditions. However, when highway speeds exceeded 55

miles per hour, the contact points were not closed long enough for the mechanical counting operation to function. Laboratory tests proved that eight milliseconds closed circuit is required for reliability. Field adjustment of contact point gap was often critical to .001 of an inch. Too wide a gap did not give enough contact closure time. Less gap caused contact bounce, giving two signals to the circuit. Contact bounce caused extra recordings, commonly called "doubling." Sometimes, overnight temperature and pressure changes affected the diaphragm deflection enough to cause counter failure.

Further experimentation in District XI produced the circuit shown on Diagram III in the form of an employee suggestion from C. F. Wasser, Jr. This circuit added a time constant which holds the power transistor turned on for about 12 milliseconds after the contact points break. The results were amazing. The counting mechanism was given time to function with near instantaneous contact closures. The circuit sees a contact bounce, or "doubling," as a single signal since the second contact usually comes within the added 12 milliseconds.

The operation of the more sophisticated circuit on Diagram III is as follows:

Contact point closure applies voltage across the base-emitter of transistor Q-2 and almost instantaneously charges capacitor C-2. Q-2 switches on, allowing current to flow through the base-emitter of Q-1. Q-1 switches on and current flows through the counter coil.

Upon break of the contact points, the energy stored in C-2 maintains current flow through the base-emitter of Q-2 for about 12 milliseconds, holding Q-2 and Q-1 switched on.

During the past year, approximately 75 junior counters have been used with the more sophisticated circuit of Diagram III. The modified counters count accurately on high speed multilane highways or low-speed city streets. Field adjustments of contact point gap and air pulse strength are no longer critical and time consuming. An .008 inch range of gap adjustment frequently causes no measurable change in counting accuracy. Counter failures are rare.



A typical junior counter installation, this one on the Roseville Freeway north of Sacramento. Note the counter chained to the base of the sign post and counter hose stretched across the pavement.

Following District XI's conversion to this circuitry, District VIII and several northern districts experimented successfully with it. Soon it was adopted for statewide use.

The Service and Supply Department has prepared a contract to manufacture easily installed modules for converting the remainder of California's junior counters.

The cost of components for our test assemblies was about $10 per counter. Assembly time is about 1½ hours each.

Power transistors must be mounted on a large aluminum surface that will act as a heat sink. On our test assemblies, the power transistors were mounted on the aluminum chassis.

2N2553 is a new number designation for 2N1039-1. The device is stud mounted. Only one hole is drilled in the chassis or heat sink for mounting. The 2N301 works equally well, but must be mounted on a transistor socket. Six carefull placed holes must be drilled for mounting the 2N301.

The collector electrode is common to the case of the power transistor. Therefore, the case must be electrically insulated from the chassis. Mica insulators are included with each transistor for this purpose.

There is danger of damage to all transistors if overheated while soldering. Long nose pliers or some other device should be used as a heat sink between the case and the point where heat is applied.

Transistors can be permanently damaged by incorrectly placing an ohmmeter across the electrodes.

The assemblies use two AA cells for the three-volt power supply. They are held in a Keystone Battery Holder No. 140.

Most of the circuit is assembled on a three-inch-long portion of an Erie Terminal Strip No. 3976-205-6. The terminal strip must be insulated from the counter chassis.

The TI 496 is mounted in a Texas Instrument Clip No. 10-31-052-007.

The original S.P.S.T. slide switch must be replaced with a D.P.S.T. switch to disconnect the two DC power supplies when the counter is not in use.

It is suggested that the fixed contact point in the diaphragm assembly be rounded to reduce the area of contact. Small particles of grit or dirt do not easily remove themselves once lodged between flat contact surfaces.

Oxidation of the silver contact points eventually causes enough contact resistance to disturb the circuit. Points should be polished occasionally.

Personnel

C. E. Waite Retires; Langsner, Hill and Wilson Are Promoted

Deputy State Highway Engineer Charles E. Waite, who spent the past 8 years of his 34-year career with the Division of Highways as the man responsible for its wide range of administrative activities, retired from state service on August 31. George Langsner has been appointed to succeed Waite as Deputy State Highway Engineer.

Langsner was promoted from the position of Assistant State Highway Engineer—Administration. He has been succeeded by George Hill, who has

J. E. Wilson, formerly Assistant District Engineer in the District X been Traffic Engineer for the division. office of the Division of Highways in Stockton, has become Traffic Engineer.

Waite's areas of responsibility have included overall supervision of such administrative functions as office engineering, city and county projects, service and supply, management analysis and systems research; personnel and public information, including employee safety and training; and fiscal



GEORGE LANGSNER

management. The division's budget exceeds $600,000,000 a year and its staff totals more than 16,000 employees.

Waite was born in Hutchinson, Kansas, and educated in Oklahoma. He served in the U.S. Army in 1918.



C. E. WAITE

Following his graduation from the University of Oklahoma in 1922 with a B.S. in civil engineering, he was employed by private engineering and construction firms in Oklahoma until 1927, when he moved to Yreka, California, to work for a mining concern.

He joined the California Division of Highways in 1929 and worked in design and construction in the Redding district until 1933, when he was assigned to the Fresno district as assistant district maintenance engineer. In 1935 he was transferred to division headquarters in Sacramento as assistant office engineer.

Waite moved to San Luis Obispo in 1942 as construction and location engineer for the division's central coast district. In 1947 he was promoted to District Engineer at Stockton, with responsibility for all state highway planning and operation in nine Central California counties.

Two years later he returned to division headquarters as Engineer of Design, and in 1950 was promoted to Assistant State Highway Engineer in charge of personnel, public information and related functions. He was advanced to Deputy State Highway Engineer, with additional responsibilities, in 1955, and has served in this capacity under State Highway Engineers G. T. McCoy, J. W. Vickrey and J. C. Womack.

Waite is a member of the American Society of Civil Engineers and of the Committee on Administrative Practices of the American Association of State Highway Officials. Other affiliations include the Masonic Lodge and Shrine, and the Sierra View Country Club near Sacramento.

Waite and his wife Amanda live at 505 Blackwood Street, North Sacramento. They have four daughters: Mrs. George Dewey of Bakersfield, Mrs. Clem Lambert of Arroyo Grande, Mrs. Harold Gill of Lafayette and Mrs. Phil Wenzel of Rockford, Illinois.

Langsner joined the Division of Highways in 1931 upon graduation from the California Institute of Technology. He served in the Los Angeles district (District VII) in positions of increasing responsibility, including design and other work in planning the Los Angeles metropolitan area freeway systems, and became District Engineer there in 1955. He was transferred to Sacramento headquarters office in 1957 as Engineer of Design



GEORGE A. HILL

and was appointed Assistant State Highway Engineer in 1960.

He is a native of Brooklyn, New York, coming to California in 1922.

Hill, being promoted to Assistant State Highway Engineer, is a native of Oakland, and received his engi-

neering degree from the University of California at Berkeley in 1937. He joined the Division of Highways the same year and served most of the next nine years in District VI (Fresno), except for World War II military duty with the Army Engineers in Alaska and the Pacific.

In 1946 Hill went to Yale University for a year's graduate study in traffic engineering. On his return he was assigned to District IV (San Francisco), and served there until 1953 in construction, traffic analysis and planning functions.

In 1953 he was promoted and transferred to the design department in division headquarters in Sacramento. In 1955 he became District Engineer in Los Angeles and returned to Sacramento as Traffic Engineer in 1962.

J. E. Wilson, being promoted from Assistant District Engineer—Operations, Stockton, to Traffic Engineer of



J. E. WILSON

the Division of Highways, is a native of Berkeley and received his engineering degree from the University of California in 1947 after having served with the Navy in the Pacific from 1944 to 1946.

Although he had worked earlier as a summer employee of the Division of Highways, he became a permanent employe in Stockton in 1949. Wilson advanced to become District Traffic Engineer, Assistant District Engineer —Administration and Assistant District Engineer—Operations. As Division Traffic Engineer he will have the civil service rank of Principal Highway Engineer.

INTERNATIONALLY KNOWN LABORATORY CHIEF RETIRES

Francis N. Hveem, Materials and Research Engineer for the State Division of Highways, retired on September 30, culminating a 45-year engineering career which has brought him an international reputation in the field of highway research and testing.

Testing equipment, procedures and design theories developed by him and under his supervision have been accepted and used throughout the United States and many foreign countries and, in turn, engineers from abroad have come to the United States to study his methods.

Some of the better known devices and test methods he developed are the



FRANCIS N. HVEEM

stabilometer, the cohesiometer, the kneading compactor, sand equivalent apparatus and profilograph. The series of barrier crash tests using remote controlled vehicles and anthropometric dummies which he promoted and directed has furnished valuable highway design and safety information now being used by other highway departments throughout the United States. His formulas for the design of asphalt pavement are also recognized as one of his outstanding contributions to the highway science field.

He is the author of more than 40 technical papers, most of which have been presented before meetings of the Highway Research Board, the American Society for Testing Materials, the American Concrete Institute and the Association of Asphalt Paving Technologists.

Among Hveem's honors are the Highway Research Board's award for the paper of outstanding merit in 1949 and the Roy W. Crum Award for distinguished service in 1956. The University of California has awarded him an honorary membership in the university's chapter of Chi Epsilon, civil engineering honor society.

Hveem was born at La Moine, Shasta County, and received his early schooling at the nearby community of Delta.

He started his career with the State in 1917 as a draftsman for the Division of Highways in Dunsmuir.

He became an assistant resident engineer in 1918 and a resident engineer in 1924. He was promoted to maintenance superintendent in 1925.

In 1929 he joined the Materials and Research Department, having attracted the attention of its then chief, the late Thomas E. Stanton, by his independent field research in design and control of bituminous mixtures for highway surfacing. It was during the ensuing years that Hveem began to build a national and later international reputation, first as a specialist in bituminous mixes and later extending into the broader field of highway research and testing.

Hveem was named Construction Engineer for the division in 1950; and in 1951, on the retirement of Stanton, returned to the laboratory as its chief. He played a leading role in the planning and operation of the test track in Idaho, a co-operative project of the 11 western states with federal agencies and private industry. He also helped plan the national test road in Illinois. The purpose of these test roads was to analyze the effect of loads of varying weight on different types of highways.

. . . Continued on page 48

LABORATORY CHIEF RETIRES . . .

. . . Continued from page 47

The Materials and Research Department now has more than 300 employees, not including 350 people operating 11 district laboratories throughout the State. The work assigned to the department is carried on in five sections: Administration, Foundation, Pavement, Structural Materials and Technical (the latter primarily concerned with cement, concrete and chemicals).

To give some idea of the volume of the department's activities, a perusal of the last fiscal year's report shows that it tested nearly 11,000 samples of asphalt, some 14,500 concrete cylinder specimens and 9,000 control checks on samples representing 2,500,000 barrels of cement. Numerous other tests were made on prestressing and structural steel, barrier cables, electrical equipment, sheeting and paints. The division's 11 district laboratories performed more than 166,000 tests on soils and aggregates. The Materials and Research Headquarters Laboratory at 5900 Folsom Boulevard, Sacramento, conducts all basic research involving materials while the district laboratories handle most of the materials testing.

Much in demand as a consultant, Hveem has traveled through much of the United States and abroad, has accepted invitations from national highway departments in Argentina, Brazil, Mexico and Egypt, the last named through the Technical Assistance Program of the United Nations.

He holds membership in the American Concrete Institute, the Highway Research Board, the American Society for Testing Materials, the Association of Asphalt Paving Technologists and is past president of the Sacramento chapter of the American Society of Civil Engineers. He at present holds appointments to 12 national committees of technical societies including the Flexible Pavement and Rigid Pavement Design Committees of the Highway Research Board and the Road and Paving Materials Committee of the American Society for Testing Materials.

Hveem and his wife, Evelyn, have four children and seven grandchildren.

BEATON IS NEW LAB HEAD; ANDERSEN PROMOTED

Appointment of John L. Beaton as Materials and Research Engineer for the California Division of Highways and of Neal E. Andersen to succeed Beaton as the division's Equipment Engineer has been announced by the Division of Highways.



JOHN L. BEATON

Beaton succeeds Francis N. Hveem who retired as head of the division's Materials and Research Department on September 30.

Andersen is being promoted from the position of Assistant District Engineer for the division's District I at Eureka.

Beaton, prior to his appointment as Equipment Engineer late in 1962, had been an assistant to Hveem since 1951, with responsibility for the structural materials section of the department. One of his recent assignments was planning and supervision of tests using radio-controlled cars to determine the most effective types of median barrier for use on freeways.

A native of San Francisco, Beaton attended high school in Sacramento and first joined the Division of Highways as a rodman and axeman on the Kings River Canyon project. He worked on highway projects during summer vacations while attending the University of California and was assigned to the Bridge Department upon his graduation with a B.S. degree in civil engineering in 1937.

In 1945 Beaton transferred from the Division of Highways to the State Personnel Board, where he served as senior engineer examiner for four years. On his return to the division, he worked in the Design and later the Personnel Departments before joining the Materials and Research Department in September, 1951. He was promoted to Equipment Engineer in December, 1962, upon the retirement of Earl E. Sorenson.

Beaton is the author of professional papers which have appeared in the proceedings of the Highway Research Board and covered such subjects as the testing of concrete bridge rails and median barriers, causes and repair of bridge deterioration due to corrosion, radiographic inspection of welded bridges, and corrosion of metal culverts.

Beaton served as president of the Sacramento section, American Society of Civil Engineers, in 1962. He and his wife Rosina have two children, Richard, a student at Sacramento State College, and Judy, a student at El Camino High School.

The new Equipment Engineer, Andersen, has been Assistant District Engineer in charge of planning for District I, in northwestern California, since May, 1961.

A native of Brooklyn, New York, Andersen holds both bachelor and master of science degrees in civil engineering from Columbia University. He served in the U.S. Air Force as a transport pilot in both World War II and the Korean conflict.

His engineering career began in the eastern states and included structural design of industrial plants and bridge design for the New Jersey Turnpike.



NEAL E. ANDERSEN

He moved to California in 1953 as a junior civil engineer in District X, with headquarters at Stockton, and held various positions of increasing responsibility during the ensuing eight years in the fields of traffic engineering, construction, and advance planning. He was Advance Planning Engineer for the district when he was promoted to Assistant District Engineer of District I two years ago.

In his new assignment, Andersen will have responsibility for the extensive automotive equipment and specialized maintenance and construction equipment used by the Division of Highways.

He and his wife Marion have a son Donald, 15.

Route Adoptions

C.H.C. Actions Include Six Freeway Sections

The California Highway Commission adopted routes for six sections of freeway at its July and August meetings. Four of the route adoptions were for highways in San Diego County. The others were in Lake County and in Yolo County. One route for a conventional highway in Yolo and Colusa Counties was adopted.

San Diego County

The San Diego County freeway route adoptions are:

For 2.3 miles of State Highway Route 282 between the adopted route for Route 280 and Blossom Lane. The adopted route is three miles south of La Mesa. For the most part it runs just west of Sweetwater Road and coincides with Sweetwater Road at Blossom Lane.

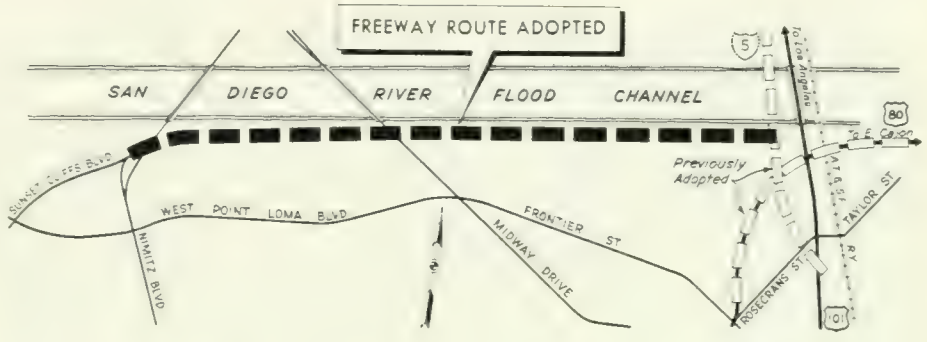
Route 282, when completed, will link together eight present and future state freeways in the San Diego area.

For State Highway Route 286 between Sunset Cliffs Boulevard and the adopted route for Interstate 5. The adopted route runs just south of and parallel to the San Diego River Flood Channel.

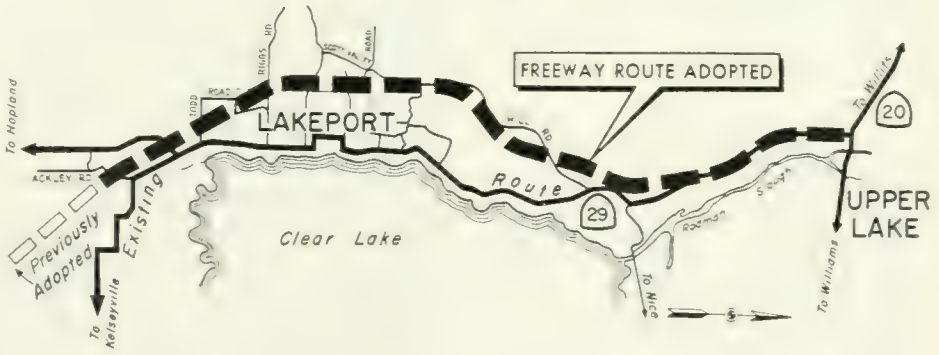
For portions of State Sign Route 94 and State Highway Route 280.

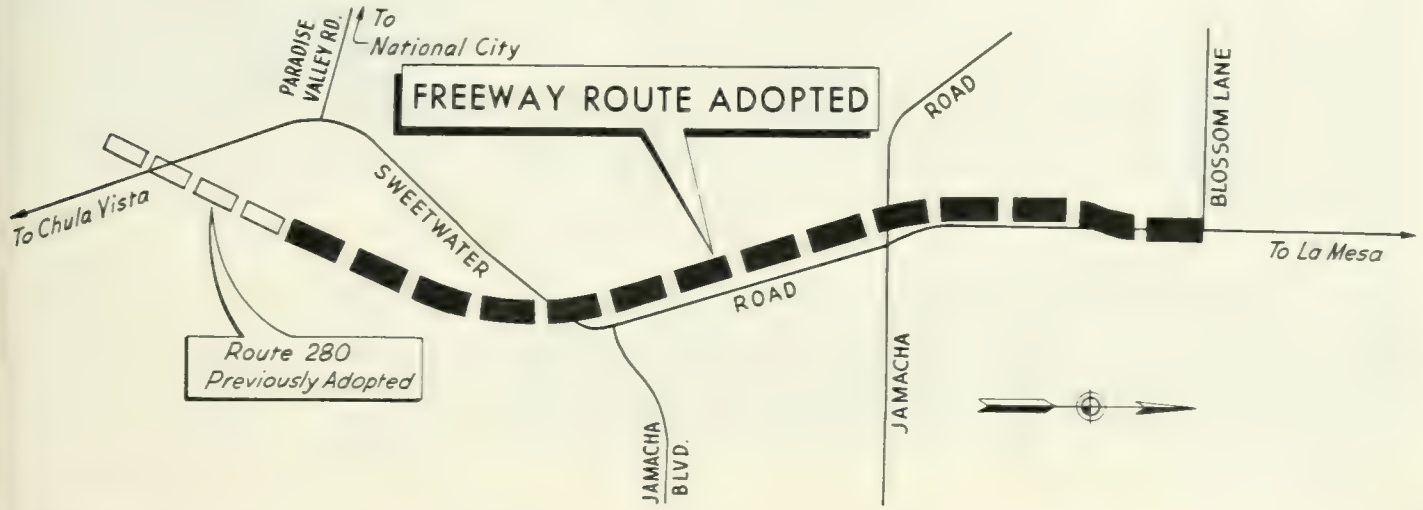
Sign Route 94

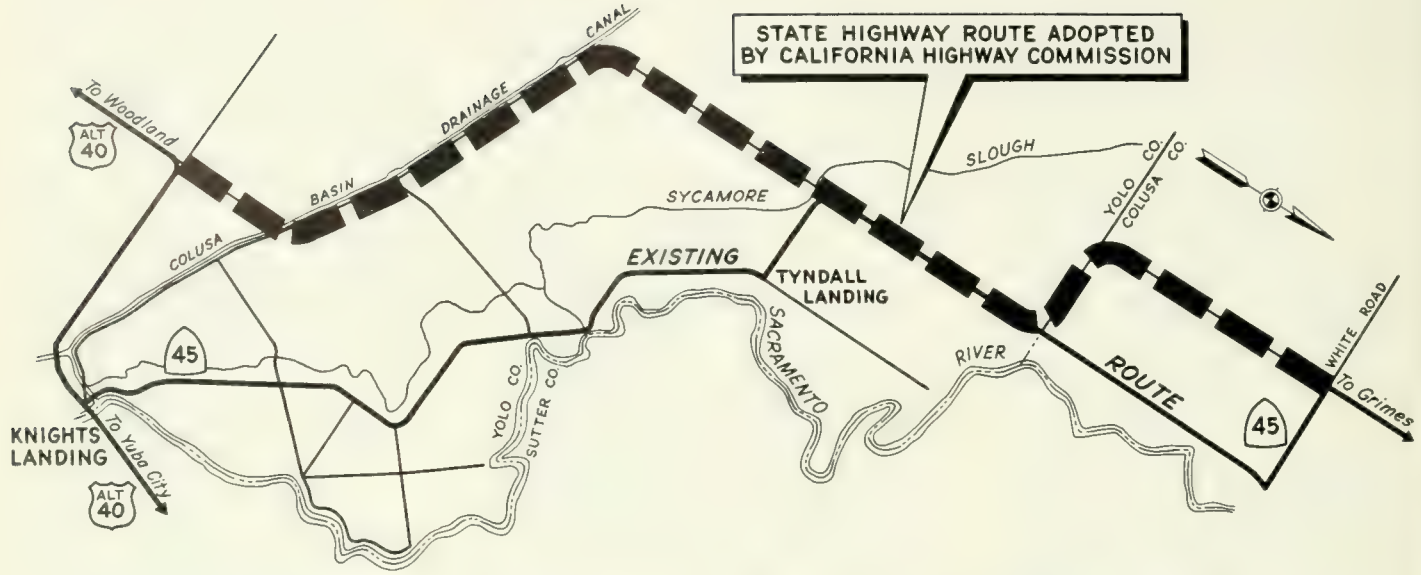
The adopted routing for Sign Route 94 is 1.6 miles in length in the vicinity











of Jamacha Junction. It is a revision of a previously adopted route which follows Campo Road. The adopted route is a short distance to the south of the previously adopted route and on a more direct line.

The adopted routing for Route 280 extends 10.1 miles between 0.4 mile east of Sweetwater Road and a junction with U.S. Highway 80 (Interstate 8) in El Cajon. For portions of its length it is in the vicinity of Jamacha Boulevard and Jamacha Road.

The Lake County freeway routing is for 12.1 miles of Sign Route 29 in the Lakeport area. It relocates the highway to the west of Lakeport and extends from 1.1 miles south of State Highway Route 16 (Hopland Road) to Sign Route 20.

Yolo County

The Yolo County freeway routing is for 12.1 miles of U.S. 99W (Interstate 5) between County Road 18, south of the community of Yolo, and the Dunnigan Cutoff (Interstate 5W). It generally parallels the existing highway on the west, with variations in the Zamora and Yolo areas.

The conventional highway routing is for the relocation of 15.5 miles of Sign Route 45 between U.S. 40 Alternate near Knights Landing and White Road about 8 miles south of Grimes. For the most part the adopted route is west of the existing highway.

J. C. Womack Is Named Among Public Works 'Top Ten'



National Public Works Week, observed annually throughout the nation in September, was again highlighted in 1963 (September 8-14) by the selection of the "top ten public works men-of-the-year." One of them was State Highway Engineer J. C. Womack, who is shown above (center) receiving the official plaque from Carl L. Richey (left), chairman of the Public and Business Affairs Committee of the Sacramento Kiwanis Club, while Highway Transportation Administrator Robert B. Bradford looks on at right. The observance is sponsored jointly by Kiwanis International and the American Public Works Association, in co-operation with several other organizations.

"The selections of the top 10 were made," according to a statement from the A.P.W.A., "in recognition of noteworthy public service reflecting the highest standards of professional conduct."

Womack was the only state highway official in this year's "top 10." The A.P.W.A. called attention to his career with the California Division of Highways dating back to 1929 and his service as chief of the division since 1959, as well as the magnitude of California's highway program which he is responsible for carrying on. It also took note of his recent terms as president of both the American and Western Associations of State Highway Officials.

"Living Pavements"

Division Experiments To Reduce Cracking

By D. L. SPELLMAN, Supervising Materials and Research Engineer

Living pavement?

Not quite true, but if you water it down, it grows. That's what happens when a new type cement is used in portland cement concrete pavements. Recent developments in expanding cements, which appear to make their expansion predictable and controllable in laboratory experiments, prompted the Division of Highways to experiment with actual pavements in an attempt to reduce cracking, and perhaps, to eliminate bothersome and expensive joints.

Ordinary concrete shrinks when it is allowed to dry out. This reduction in volume makes it necessary to construct what is known as "contraction joints" in concrete structures and pavements.

We are all familiar with the grooves or joints in concrete pavements and sidewalks.

If joints were not constructed, many cracks would form anyway, but not along neat, straight lines, nor at controlled spacing. About the only advantages of straight "cracks," aside from esthetic considerations, are that they are easier to maintain (seal), if they should require sealing, and may tend to spall less.

Sealing and controlling spacing helps prevent intrusion of foreign material which sometimes causes spalling. But, all the reasons for spalling of joints are not clearly understood. Some joints spall while others nearby do not spall, yet there is no clear-cut explanation as to why this should occur.

340 Joints per Mile

If it were possible to make a concrete that would not shrink, or otherwise change volume, no joints would be necessary. If volume change is reduced, joints can be spaced further apart. At the present spacing used in California pavements, there are about 340 contraction joints per mile.

For a 24-foot wide pavement (2 lanes), the cost of sawed joints

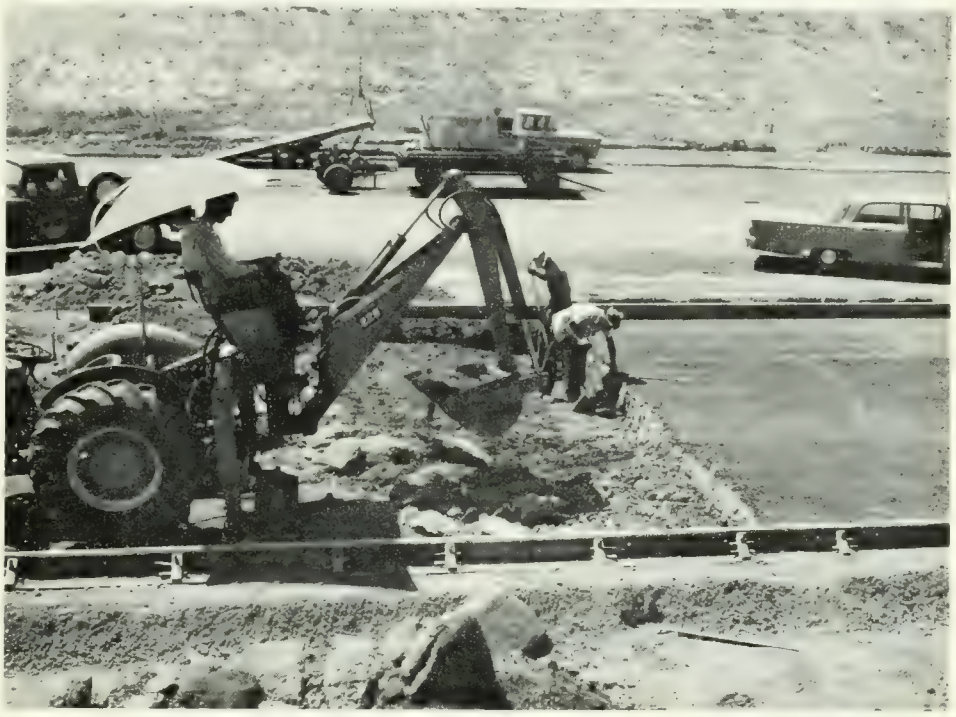


PHOTO 1. End anchors, which were thick concrete blocks, were constructed on the ends of the expending cement units. The anchors prevented movement of the ends of the pavement, causing a buildup of compressive stress in the pavement during the curing period.



PHOTO 2. Special contractor-built spray rig keeps pavement wet until plastic membrane can be applied.



PHOTO 3. White polyethylene plastic sheeting shown being rolled into place over previously wet pavement for purposes of curing the expanding cement section.

amounts to about $1,200 per mile. Expanding cements offer one possibility of eliminating most of this cost. Here's how!

Originally, various materials that would expand when wet were added to portland cement in varying amounts. The idea was to make concrete expand while curing and in so doing, stress imbedded steel and thus produce a "self-stressed" reinforced concrete similar to present day prestressed concrete. Of course, this expansion shouldn't happen too soon, nor expand too much because if the concrete "stressed" itself before it gained sufficient strength, it would destroy itself. This happened in early experiments with expanding cements in the laboratory. The French apparently experimented with expanding cements about 70 years ago, and more recently, the Russians. Their problem was that expansions were not always predictable nor controllable. The result was only limited success with a novel idea.

Possibility of Less Shrinkage

When information was presented to F. N. Hveem of the Division of Highways Materials and Research Department that an expansive component had been developed which could be controlled, the thought occurred to him that it might be useful in offsetting the shrinkage of nonreinforced pavements if used in smaller amounts than were used for self-stressing purposes.

After conferences with the developer, Professor Alex Klein of the University of California, a plan evolved for an experimental application of the idea in actual pavement construction. The amount of "component" was to be relatively small, about 15 percent, blended with 85 percent of a regular Type II cement. Preliminary data on cements containing various amounts of the expansive component, reported in technical publications, were used in selecting the 15 percent value.

Several laboratory tests were made on small quantities of concrete to develop as much knowledge as possible about the characteristics of such cement before its use in an actual pavement. This cement has become known as "shrinkage compensated cement."

Theory Explained

The theory was that if the ends of the pavement could be restrained while the concrete was curing and trying to expand, a compressive stress would be built up within the concrete itself. Despite its apparent hardness, concrete is elastic and can be compressed. Compression was to be obtained, not by squeezing the ends of the pavement, but rather by simply restraining the ends as the concrete tried to "grow." At the end of the curing period, while still wet, the concrete would be in a state of compres-

sion depending upon how much component was used, the effectiveness of the curing, and the degree of success in keeping the free ends of the pavement from moving. When allowed to dry, the concrete, which would shrink absent the prior restraint, would be relieved of most of the compressive stress developed during the curing period. If successful, a small amount of compressive stress would remain. The concrete would not go into tension, and therefore, would not crack.

Laboratory tests indicated that pigmented curing compounds would not retain sufficient moisture in the pavement long enough to complete expansion. The tests indicated that curing with white plastic membrane, after thoroughly prewetting the concrete, would be adequate to obtain most of the potential expansion after six days of curing.

Specifications Written

Specifications were written for a test section 1½ miles long containing six ¼-mile units. Four units were to contain shrinkage compensated cement; two units were to contain regular job cement, as a control; and, all units were to be cured seven days with white plastic membrane.

No joints were to be used in any of the six experimental units, although construction joints could be formed at the end of any unit. Where a joint did occur at the end of any shrinkage compensated cement unit, an end anchor was to be constructed. End anchors are thickened end blocks of concrete about 15 feet long, tapering from a thickness of 8 inches to about 2 feet. Photo No. 1 shows one of these anchors being constructed.



PHOTO 4. Wet earth cure was used on a portion of the experimental pavement at Lodi. The earth was kept wet round-the-clock for seven days by frequent sprinkling.

Projects Selected

Two current projects were selected for installation of experimental sections. One was for the construction of a portion of the Antelope Valley Freeway in District VII, and the other was for converting U.S. 99, near Lodi in District X, to freeway status.

On the first test section constructed, part of the Antelope Valley Freeway, lugs were cut into the subgrade in addition to end anchors to increase resistance to sliding, but measurements and analysis of strain data indicated that they were not needed. The end anchors alone, apparently, were sufficient and were the only means of restraint used for the second and later test section near Lodi.

Half of the units in each test section had air-entrained concrete, and half were non-air-entrained. For the Antelope Valley Freeway section two cement factors were used, 6 and 6½ sacks per cubic yard, while a single cement factor was used in all units of the Lodi section.



PHOTO 5. This photo shows Carlson type strain gages being installed in the plastic concrete to measure internal movement or "growth" that occurred.



PHOTO 6. Changes in length of the concrete were measured by means of a comparator. Holes were cut in the plastic sheeting to reach gage plugs cast in the concrete.

Curing Changed Somewhat

The curing for the Lodi job was also changed somewhat. Early data, obtained from the Antelope Valley Freeway section indicated that expansion had stopped after about three or four days. It was believed that the reason might have been lack of moisture. For this reason, half the units in the Lodi section were cured with wet earth instead of plastic membrane as originally planned. The pavement was kept wet by a special spray bar constructed by the contractor (see Photo No. 2), until it had hardened sufficiently to support the wet earth. See Photos Nos. 3 and 4 showing the two types of curing membrane in place.

Surface gauge plugs and internal strain gauges were used to measure length changes in the concrete. See Photos Nos. 5 and 6. Gauge readings established the fact that vertical expansion was greatest, transverse movement was intermediate, and longitudinal movement was almost nil, indicating that the concrete had gone into compression in a longitudinal direction. Of course, measurements are useful, but the real proof of success is measured by the crack interval or slab lengths that result.

Results Not Encouraging

Results so far are not too encouraging. After 58 days, following removal of curing membrane on the Antelope Valley Freeway section, the average distance between cracks in the special cement units was 60 feet, while the average in the control units was 56 feet. This indicates that little, if any, benefit was gained by using the special cement. It now appears that a larger percentage of component could have been used as not all the desired expansion took place. It was not expected that the expansion under field conditions would be as great as that measured in laboratory tests, but it was anticipated that enough would take place to secure the desired result.

One interesting development was the difference in crack spacing as between the air-entrained and non-air-entrained units on the Antelope Valley Freeway section. The average distance between cracks for the air-entrained units was 48 feet at 58 days, while the average for the non-air-entrained units was 70 feet. This indicates that under the conditions existing for this pavement, the air-entrained concrete may have had substantially greater drying shrinkage.

Cracking Patterns Similar

The Lodi section has yielded little data to date, but preliminary measurements and observations show that cracking patterns will be similar to those obtained on the Antelope Valley Freeway section. Cracks have appeared in all units despite the additional precautions taken to secure thoroughly wet conditions during the curing period.

After about three weeks of natural drying following the end of the curing period, the average distance between cracks in the special cement units was 68 feet, while the average in the control units was 65 feet. Again it appears that the use of expanding cement has not resulted in appreciably fewer cracks than the use of job cement. There was also little difference between the plastic cured units and the wet earth cured units.

Further analysis of the data may show why greater differences did not occur. It might be that the concrete underwent plastic flow, or creep, as the expansion took place, thereby preventing development of much compression. The use of a larger percentage of expansive component may be necessary to develop the desired effect.

Others, also, are investigating the use of this interesting material. A self-stressed, reinforced concrete pavement is being planned by the State of Connecticut. More research work is being carried on in laboratories. As with most "new" materials, it will take some time to "discover" all the uses that may be made of it. This, of course, is part of the function of the Materials and Research Department of the California Division of Highways.

FOG WARNING CONFERENCE

Officials of the Division of Highways, the Department of Motor Vehicles and the Highway Patrol met met with an advisory group of representatives of the automobile clubs, insurance companies, law enforcement agencies and bus and truck operators on August 12 in Sacramento to begin a study of ways to provide advance warning to motorists of fog conditions.

Japan's Highways

Economic Growth, Olympics Spur Road Development

Imagine trying to design and build an expressway without the ability to acquire right-of-way through eminent domain or tax the people for funds. Where does one go with his road and where does he get the money once he's found the route?

The Japanese make their concrete strips go through mountains, over or under swamps and rivers and around the borders of preferred property like ribbons—and they do most of it on borrowed money.

Burton Sherman, Senior Delineator at District VII, traveled to Japan last year on the invitation of the Japan Highway Public Corporation, Nihon Doro Kodan, returning a visit made by Ken-ichi Fujimoro, present chief of the Highway Planning Department, to District VII in 1958. Because of his interest in highways, Sherman was given a complete tour of Japan's Nagoya-Kobe Expressway, their first modern divided highway, where he made color slides of construction and acquired plans and maps for lectures. A major stimulus for Japan's highway growth, in addition to its anticipated increase in economic growth rate, is preparation for the upcoming 1964 Olympic games. They have been proceeding under the prevailing five-year program, planned for 1961-65, including 305 billion yen ($847 million) for toll roads built by Nihon Doro Kodan.

Tax, Right-of-way Limitations

Tax and right-of-way limitations have necessarily altered Japanese road-building so as to make some of their



A completed section of the Nagoya-Kobe Expressway near Kyoto City shows emergency pulloff areas. The median barrier is planted with bushes, as are the dividing strips for rest areas.



Spiral approaches to the Ondo Ohashi Bridge are shown at night.

Mr. Nakamura, guide and interpreter supplied by Nihon Doro Kodan; Burt Sherman; and Mr. Tanaka, paving specialist for NDK, study plans at a construction site.

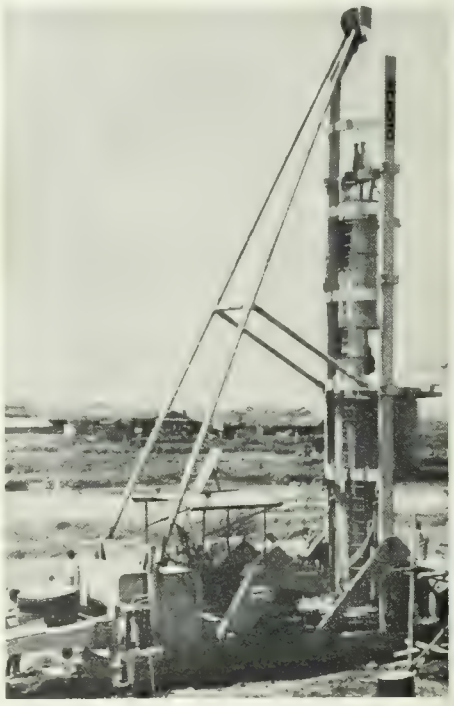


methods quite different from ours. One of the most striking examples is the spiral bridge approach across the Ondo Strait of the Inland Sea, connecting Kure City and Ondomachi. In order to reach a high elevation in a minimum space, the bridge approach ramp rises in a relatively steep manner, spans the river and descends in the same fashion. It looks much like our pedestrian overpass.

All of the roads built by Nihon Doro Kodan are toll facilities and have rest and amusement areas, also run by this group, along the traveled way. Bus stops are provided along the routes—30 on the Nagoya-Kobe Expressway alone.

Nihon Doro Kodan is a private corporation, under the supervision of the Minister of Transportation, created in 1956 to build roads. They are a private concern but are financed from several different sources, including the government. They were set up as a private concern so that they could sell

The French Benoto machine, which has been the subject of much inquiry by District VII bridge engineers, is used widely in Japan to bore for and insert bridge pillars.





Two-level Shimamoto and Kajiwara Tunnels, also part of the Nagoya-Kobe Expressway, are seen under construction. When completed, the higher level tube will carry motorists to Kyoto and the lower one to Kobe.

bonds as well as borrow government money.

Road Bonds Sold

Road bonds sold to Japanese investors bring 46 percent of the necessary funds; capital funds from the Japanese government, 15 percent; loans from the Trust Fund Bureau of the Ministry of Finance, 15 percent; loans from the International Bank for Reconstruction and Development, 11 percent; toll revenues, 10 percent; subsidies from the government, 3 percent. Gas tax money is also used now to help meet financial needs.

The NDK is licensed to build and operate, as toll facilities, expressways, highways, tunnels, bridges, ferry services, parking places, rest houses and gas stations on expressways, and office rooms, shops and warehouses located under viaducts or other of their structures.

They have completed 49 toll roads (237 miles) and are constructing 24 more (114 miles). The Kanmon Undersea Highway Tunnel, a 2.08-mile tube connecting Kyushu Island with the mainland (Honshu), is the only one of its kind in the world.

Nagoya-Kobe Expressway

The Nagoya-Kobe Expressway is the corporation's biggest project. It was begun in 1957 and its completion is planned for 1964. The road will be 112.8 miles long and is estimated to cost $320 million, $100 million of which is expected to be loaned from the World Bank. Three foreign engineers assisted in the planning, designing and construction of the expressway, two Americans—from Texas and Nebraska—and one German. Estimated daily traffic will be about 11,000 vehicles, 77 percent of which should be trucks. The area served by the expressway includes four of Japan's six major cities.

—Karen L. Bailey

(Editor's Note: A consultant to the Japanese Ministry of Construction on the original feasibility studies for the Nagoya-Kobe Expressway in 1954 was J. C. Womack, at that time Advance Planning Engineer for the California Division of Highways and now State Highway Engineer.)

West Placerville Freeway

By FRANK V. RAKELA, Associate Highway Engineer



The first section of four-lane freeway on U.S. 50 in El Dorado County between Sacramento and Placerville was opened to traffic August 15, 1963, with a colorful ribbon-cutting ceremony marking the initial day of the county fair, located adjacent to an interchange.

This 2.8-mile stretch of modern highway runs from Perks Corner (Missouri Flat Road) to the Placerville west city limit and replaces 3½ miles of narrow, heavily commercialized two-lane conventional roadway. The new alignment bypasses the loop in the old route as shown on the accompanying map.

U.S. 50 was one of the first routes to be included in the original California state highway system. Heavy traffic has been commonplace over it for the past century.

Hundreds of Freight Wagons

Early records and photographs show that during the 1860's hundreds of freight wagons passed through Placerville (then called Hangtown) destined for the Comstock mines in Nevada. With payloads ranging from drygoods to blasting powder, these creaking earlyday vehicles were drawn by oxen or horses. Mule trains were not uncommon.

Traffic in those days was said to be so heavy that "if a wagon dropped out of the nose-to-tailboard stream of traffic, it waited until nightfall to get back in line."

Closing the Comstock mines had only temporary effects on the traffic. And recent counts show an average daily traffic of 12,000 vehicles of all types in the Placerville area with peak-hour traffic as high as 1,900 vehicles.



The completed Webber Creek piers prior to construction of the superstructure of the bridge.



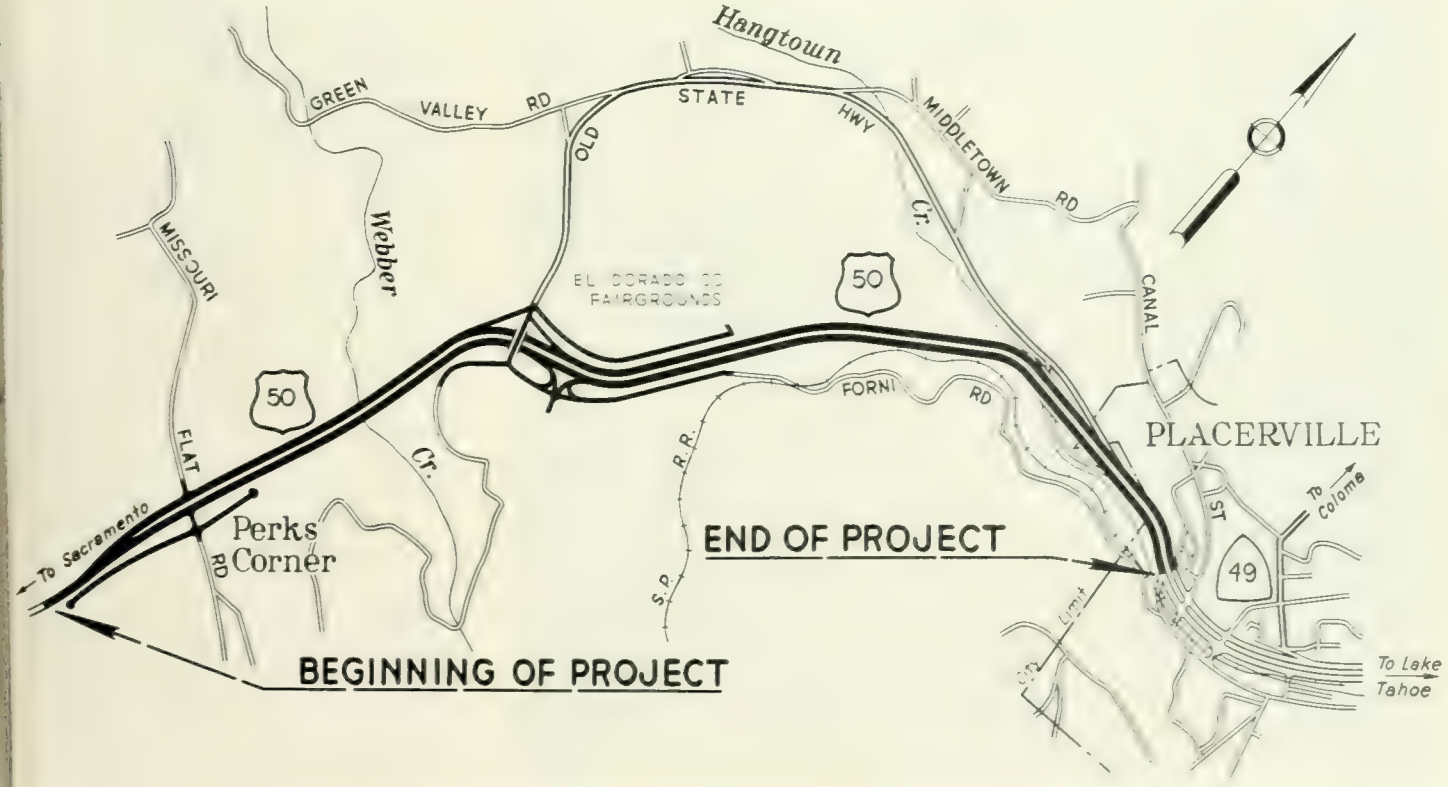
A night shot of the round-the-clock slipform pouring of the pier shafts on the Webber Creek twin bridges. The lines of light on the old highway to the right were caused by the headlights of oncoming cars.



A southwest view of the new freeway showing the fairground interchange and Webber Creek bridge in the distance. The county fairground can be seen upper center.



A closeup of the fairground interchange and Webber Creek bridge.



A map showing the location of the new freeway section in relation to the City of Placerville and neighboring points.



Traffic on the old highway near the east end of the project passes through a commercialized area which fronts close upon the roadways on both sides.



Typical traffic flow on the new freeway in the vicinity of the new Webber Creek bridge.

Completion of this latest project now provides a total of seven miles of uninterrupted four-lane freeway and expressway through the Old Hangtown area. At the present time two other jobs are under way east of Placerville. When these are opened to traffic—probably by the end of next year—along with previously completed sections, motorists traveling U.S. 50 will enjoy 25 miles of four-lane highway running from three miles west of Placerville to Riverton.

Construction on the west of Placerville job—with maximum grades of 6 percent and 1,200-foot-minimum radius of curves—required some 950,000 cubic yards of excavation. A rocky sidehill cut near the east end of the project yielded 300,000 yards of it. Here the existing road had a 80-foot cut slope on one side and Hangtown Creek on the other. Extensive drilling and shooting was necessary in this area, and, because of the proximity of the old highway and heavy traffic involved, blasts were kept small to minimize traffic delays.

Widespread Mining Operations

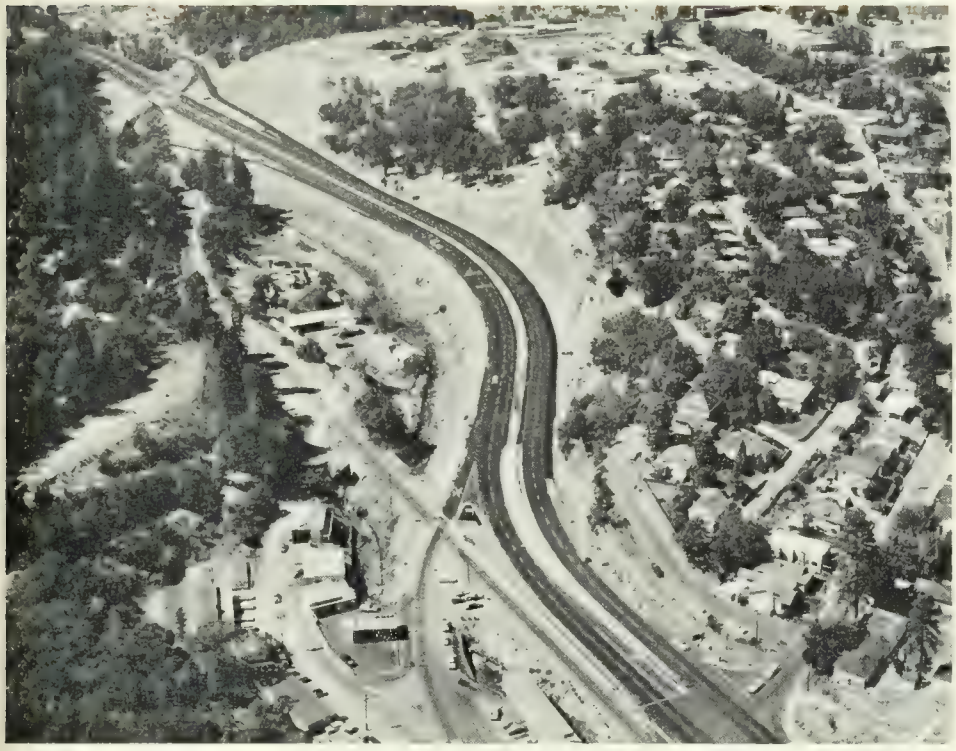
The widespread Gold Rush mining operations were reflected in the two aggregate sources used: the site near Placerville consisted of hydraulic tailings and the one near Coloma was dredger tailings.

Structural section of the roadway is 12 inches of class 1 aggregate subbase, 8 inches of plant-mixed class B cement-treated base, 4 inches of class B asphaltic concrete, and one-half-inch open-graded asphaltic concrete as a wearing surface.

Bridgework included overcrossings at Forni Road (fairground interchange) and at Placerville Drive (old highway), and twin, parallel bridges over Webber Creek.

The Webber Creek structures each are four-span welded plate girder bridges 551 feet in length. Shafts of the supporting concrete piers which ranged from 70 to 135 feet in height were built by the slipform method in a round-the-clock concrete placing.

Abutments are also concrete and the 100-foot embankment on the east was constructed of rocky material in



Looking west from the end of the project at West Placerville city limit where the new freeway connects with the existing expressway through the city.

8-inch lifts. Settlement of the fill was negligible.

Both structures feature an experimental concrete roadway deck. Type I cement was used on two spans of each structure and type II low alkali cement was used on the other two spans. In addition two of the spans in each structure used Bear River aggregate from near Colfax, about 50 miles northerly of the project. Aggregate for the other two spans in each structure was imported from the Pleasanton area in Alameda County, a haul of approximately 145 miles.

Differing amounts and distribution of reinforcing steel were used in the eastbound structure. Electrical thermocouples and strain gauges were cast into the deck and several series of load tests were made. The primary purpose of the experimental work was to determine the effect of various combinations of aggregate, cement, and reinforcement on concrete shrinkage and on the development of cracks in the deck slab. Further tests are planned.

Fredrickson & Watson Construction Co. of Oakland was contractor, and construction cost was approximately $3,240,000. R. G. Elliott was resident engineer during staking, and the author during construction. R. N. Brink was Bridge Department representative. Superintendent for the contractor was Paul Fields.

SPB Establishes New Administrative Class

A new series of four administrative classes has been established by the State Personnel Board for the Division of Highways.

Highways administrative officers I through IV will be responsible for nonengineering duties such as personnel, training, office management, building management, automotive management, and supply and property management. Administrative officers may handle additional staff work, depending upon the needs and size of the district in which they are employed.

This series is intended to simplify the job structure of the division and to provide personnel specifically trained in management and administrative techniques.

The pay scales range from $590 starting salary for a HAO I to a maximum of $1,166 for a HAO IV. Promotional examinations for positions at the I, II, and III level are tentatively scheduled for December 14, 1963, with a final filing date of November 22, 1963. An examination for the IV level will be scheduled later.

TOLL BRIDGE AUTHORITY RE-FUNDS BOND ISSUES

The California Toll Bridge Authority took action on September 25 to re-fund the bond issues of 1955 and 1959 which financed the Carquinez and Benicia-Martinez toll bridge projects and at the same time authorized use of toll bridge bond funds to finance construction of an improved 12-mile bridge approach between Benicia and Interstate 80 near Cordelia.

The authority acted on the recommendation of the Department of Public Works in both instances.

Department officials, with the support of legal and financial experts, pointed out that the current condi tion of the bond market indicated a saving of more than $3,000,000 in interest costs over the life of the bond issues, in comparison with the interest rates prevailing at the time of the previous issues.

In addition to authorizing call of the previous bonds and issuance of refunding bonds, the authority adopted a resolution making funds from the new issue available in the amount of $10,000,000 to realign and reconstruct the present two-lane State Highway 21 as a four-lane divided highway. This action was made possible by recent legislation defining this highway as a part of the approaches to the bridge.

Since regular state highway funds were not available for this construction, the use of toll bridge bond issue funds will mean advancement of the project by several years.

Earl Hampton Retires, Meret Is Appointed

Earl W. Hampton, deputy chief in charge of architectural and engineering services of the Division of Architecture, retired October 4. Tom Meret, Assistant State Architect in charge of the Los Angeles office, has been appointed to succeed him as deputy.

Hampton has been with the architecture division 38 years. He was Acting State Architect for more than a year following the retirement of State Architect Anson Boyd in 1962.



EARL W. HAMPTON

He is a native of Sacramento County.

Hampton attended the University of California in Berkeley. He received his Master of Arts degree in 1924.

In 1925 he joined the Division of Architecture staff as an assistant architectural draftsman.

Long Career

During his long career, Hampton progressed through each of the drafting and design classifications. In 1949 he was selected to administer the portion of the division's postwar design program turned over to private architects.

From 1953 to 1955 he supervised the preparation of preliminary design studies and budgetary analyses of major capital outlay construction projects proposed for the Governor's annual budget.



TOM MERET

He headed the division's budgetary and fiscal function for four years before his appointment to the deputy chief position in 1959.

In recent years he has been responsible for the planning and design functions performed by the architecture division, the division's construction supervisory forces throughout the State, and the staff operations of the schoolhouse section who checks and passes on the safety aspects of private architects' plans for public school buildings erected in California.

He is a California registered architect, and a member of the American Institute of Architects.

Hampton and his wife, Margaret, have two daughters.

Meret Joins Division

Meret joined the Division of Architecture in 1948 as an associate designer and was appointed senior designer a year later. In 1952 he was promoted to Supervising Architect.

Meret took over supervision of the construction budgets section in 1955 and later headed the division's project management section which developed improved methods for the control and management of the budgetary and working drawings processes engaged in by the division.

Meret is married and has two daughters.

IN MEMORIAM

Headquarters

Mervyn R. Blacow, Senior Landscape Architect.

Materials and Research

Nathaniel C. Martin, Engineering Aid II.

District IV

Harold Skootsky, Senior Highway Electrical Engineer.

District VI

Bentley Barnes, Highway Superintendent.

District VIII

Ralph C. Wright, Assistant Highway Engineer.

District X

Frank E. Randolph, Highway Maintenance Man I.

State-owned Toll Bridges

Thomas Hugill, Service and Maintenance Man II.

Mervyn R. Blacow

Mervyn R. Blacow, Senior Landscape Architect for the Division of Highways, died on August 18 from injuries suffered in a fall from a scaffold while painting his home.

He designed the layout of much of the roadside planting and landscaping of California's freeways throughout the State.

A native of Oakland, Blacow attended grade and high school at Irvington and Centerville and is a graduate of the University of California at Berkeley.

He joined the Division of Highways as a junior architectural draftsman in 1935. He advanced through assistant and associate grades, becoming a senior and assistant chief of the division's landscape design section in 1953.

Blacow was a Mason and active in the Boy Scouts. He was a veteran of World War II.

He is survived by his wife, Lois, and two sons and a daughter.

R. C. Richardson

Rodney C. Richardson, former assistant to the California Director of Public Works, died in St. Paul, Minnesota, on August 15, following surgery. He was 46 years old.

Richardson was born in Superior, Wisconsin, and was educated in Los Angeles. After military service in World War II, he was appointed secretary in 1944 to the Governor's Veterans Commission, predecessor of the Department of Veterans Affairs. He later held other administrative posts in state government and from 1950 to 1955 was an assistant to the Director of Public Works, serving under the late C. H. Purcell and Frank B. Durkee.

Eight years ago Richardson moved to St. Paul as an official of a large manufacturing concern.

He is survived by his wife, Antona, and a son and daughter, living in Roseville, Minnesota.

RETIREMENT

. . . Continued from page 38

icksen, Supervising Highway Engineer, 34 years; Jerome N. Stanley, Senior Highway Engineer, 34 years; Nathan C. McCorkle, Supervising Highway Engineer, 34 years; Charles E. Waite, Deputy State Highway Engineer, 34 years.

Bridge Department

Lloyd B. Dale, Assistant Bridge Engineer, 27 years; Ernest H. Sagehorn, Assistant Bridge Engineer, 33 years; Mildred I. Grant, Intermediate Stenographer, 10 years; Leonard C. Hollister, Principal Bridge Engineer, 36 years; Irene R. Schmidt, Intermediate Account Clerk, 23 years; Cecile Davies, Bookkeeping Machine Operator II, 40 years.

Materials and Research

Howard M. Aaron, Assistant Chemical Testing Engineer, 34 years.

State-owned Toll Bridges

August Sanguinetti, Janitor, 24 years; Edith T. Harrell, Intermediate Account Clerk, 25 years; Joseph E. Miguel, Service and Maintenance Man II, 17 years; Edith E. Schwalen, Senior Stenographer, 9 years.

Shops

Charles Bovey, Supervising Machine Parts Storekeeper, 42 years; William L. McFadden, Supervising Equipment Engineer, 36 years; Edwin H. Hanks, Fusion Welder, 26 years; Melvin Saunders, Fusion Welder, 19 years; Edward G. Schutt, Highway Mechanical Foreman, 28 years; Dennis L. Hicks, Heavy Equipment Mechanic, 37 years; John W. Harris, Automobile Mechanic, 30 years.

ARAMAYO VISITS CHILE

Luis Aramayo, Assistant District Engineer in District II (Redding) was chosen by Governor Brown as member of an "Alliance for Progress" task force which made a five-week study in Chile.

Aramayo, a native of La Paz, Bolivia, was selected to cover the transportation phase of the study.

Right-of-way Expert J. T. Zeeman Retires

J. T. Zeeman, Assistant Chief Right-of-way Agent for the State Division of Highways, retired on October 1, 1963.

Born and educated in Holland, Zeeman entered the real estate and mortgage loan business in the 1920's in Los Angeles following U.S. Army service during World War I. In 1939, he became deputy land assessor in Los Angeles County.



J. T. ZEEMAN

He began work with the Division of Highways in 1944, serving as right-of-way agent in District X (Stockton). Zeeman left this position to serve first as staff appraiser for the State Board of Equalization, and later as supervising appraiser for the State Savings and Loan Commissioner in San Francisco.

Returning to the Division of Highways in 1948, Zeeman has since served as real estate appraiser and supervising right-of-way agent, appraising property needed for right-of-way purposes. He was also active in the purchase of land parcels for other state agencies, including acquisition of the new State Fair site in Sacramento, Sacramento State College, and others.

He was promoted to the post of Assistant Chief in 1961 to supervise all right-of-way activities in the southern half of the State, and later became administrator of the appraisal department for all valuation activity concerning right-of-way throughout California.

Zeeman is a member of the American Right-of-way Association, Sacramento Chapter; the American Institute of Real Estate Appraisers, Northern California Chapter; the Sacramento Real Estate Board, and the Commonwealth Club of San Francisco.

He and his wife, Marie, have a daughter and three grandchildren.

Tom Bigelow Retires, With State 44 Years

Howard Thayer "Tom" Bigelow of Yuba City, highway superintendent in charge of special maintenance crews of the Marysville district office, retired September 1 following nearly 44 years with the California Division of Highways.

Born in Trinity County, Bigelow graduated from Weaverville High School in 1917 and immediately accepted employment with the Highway Division at the Dunsmuir district office (since, moved to Redding).

During a two-year period after World War I Army service, he worked for the federal government and the Du Pont Company.

In 1921 he rejoined the Dunsmuir staff as timekeeper. Six years later he was promoted to highway maintenance foreman and in 1930 was advanced to superintendent and assigned the Crescent City territory. He then served successfully in this capacity at Boonville, Sacramento, Woodland, Nevada City and Marysville.



H. T. BIGELOW

While assigned to division headquarters in Sacramento, Bigelow served as assistant to the State Maintenance Engineer.

Bigelow transferred to Marysville in 1948 and was assigned supervision of the district's special maintenance services which includes highway striping and marking, tree trimming, highway lighting, traffic signals, radio communication, signs, roadside plantings and equipment distribution.

Bigelow is immediate past state president of the Division of Highways Quarter Century Club and is a past president of the Mt. Konocti Chapter 19 of the California State Employees Association.

He is also a member of the Elks Club, Masonic Lodge No. 13, Marysville, Scottish Rite and the Marysville Post American Legion.

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

HIGHWAY TRANSPORTATION AGENCY

ROBERT B. BRADFORD . . . Administrator

DEPARTMENT OF PUBLIC WORKS . . . JOHN ERRECA, Director

FRANK A. CHAMBERS . . . . Chief Deputy Director

RUSSELL J. COONEY . . Deputy Director (Management) — HARRY D. FREEMAN . . Deputy Director (Planning) — T. F. BAGSHAW . . . . . Assistant Director

JUSTIN DuCRAY . Departmental Management Analyst — S. ALAN WHITE . . Departmental Personnel Officer

DIVISION OF HIGHWAYS

J. C. WOMACK . . . State Highway Engineer, Chief of Division

J. P. MURPHY . . . Deputy State Highway Engineer
J. A. LEGARRA . . Deputy State Highway Engineer
GEO. LANGSNER . . Deputy State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
FRANK E. BAXTER . Assistant State Highway Engineer
GEORGE A. HILL . Assistant State Highway Engineer
J. C. BURRILL . . . . . Comptroller
NEAL A. ANDERSEN . . . . Equipment Engineer
JOHN L. BEATON . . Materials and Research Engineer
C. G. BEER . . . . . Urban Planner
J. F. JORGENSEN . . . . . Construction Engineer
SCOTT H. LATHROP . Personnel and Public Information
C. T. LEDDEN . . City and County Projects Engineer
H. C. McCARTY . . . . . Office Engineer
DANA G. PENGILLY . . . . . Planning Engineer
E. J. L. PETERSON . . Program and Budget Engineer
R. V. POTTER . . . . Systems Research Engineer
E. L. TINNEY . . . . . Maintenance Engineer
W. L. WARREN . . . . . Engineer of Design
J. E. WILSON . . . . . Traffic Engineer
A. L. ELLIOTT . . . . Bridge Engineer—Planning
L. C. HOLLISTER . Bridge Engineer—Special Projects
I. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area

Right-of-Way

RUDOLF HESS . . . . . Chief Right-of-Way Agent
DEXTER D. MacBRIDE . . . . . Assistant Chief
RAY E. O'BIER . . . . . Assistant Chief
R. S. J. PIANEZZI . . . . . Assistant Chief
JACQUES T. ZEEMAN . . . . Assistant Chief

District I, Eureka

SAM HELWER . . . . . District Engineer

District II, Redding

H. S. MILES . . . . . District Engineer

District III, Marysville

ALAN S. HART . . Assistant State Highway Engineer

District IV, San Francisco

J. P. SINCLAIR . . Assistant State Highway Engineer
R. A. HAYLER . . . . . District Engineer
HAIG AYANIAN . . . . . District Engineer
C. F. GREENE . . . . . District Engineer

District V, San Luis Obispo

E. R. FOLEY . . . . . District Engineer

District VI, Fresno

W. L. WELCH . . . . . District Engineer

District VII, Los Angeles

E. T. TELFORD . . . Metropolitan District Engineer
A. L. HIMELHOCH . . . . . District Engineer
A. C. BIRNIE . . . . . District Engineer
A. W. HOY . . . . . District Engineer
R. E. DEFFEBACH . . . . . District Engineer

CALIFORNIA HIGHWAY COMMISSION

ROBERT B. BRADFORD . Chairman and Administrator, Highway Transportation Agency
JAMES A. GUTHRIE . . Vice Chairman San Bernardino
ARTHUR T. LUDDY . . . Sacramento
ROGER S. WOOLLEY . . . San Diego
ABRAHAM KOFMAN . . . . Alameda
FRANKLIN S. PAYNE . . Los Angeles
WILLIAM S. WHITEHURST . . . Fresno

JOHN ERRECA . Administrative Officer and Director of Public Works
JACK COOPER, Secretary . . . Sacramento

District VIII, San Bernardino

C. V. KANE . . . . . District Engineer

District IX, Bishop

C. A. SHERVINGTON . . . . . District Engineer

District X, Stockton

JOHN G. MEYER . . . . . District Engineer

District XI, San Diego

JACOB DEKEMA . . Assistant State Highway Engineer

State-owned Toll Bridges

CHARLES L. SWEET . . . . . Bridge Engineer

DIVISION OF CONTRACTS AND RIGHTS-OF-WAY

HARRY S. FENTON . . . . . Chief Counsel

EMERSON RHYNER . . . Deputy Chief (Sacramento) — HOLLOWAY JONES . . . Deputy Chief (San Francisco) — GEORGE C. HADLEY . . . Deputy Chief (Los Angeles)

DIVISION OF BAY TOLL CROSSINGS

BEN BALALA . . . . . Acting Chief of Division

DIVISION OF AERONAUTICS

CLYDE P. BARNETT . . . . . Director, Chief of Division

95667 9-63 54M

printed in CALIFORNIA STATE PRINTING OFFICE

Traffic Safety Conference



Division chairmen and officials of the Governor's Traffic Safety Conference listened intently as Governor Edmund G. Brown delivered the keynote speech at the opening general session in the Memorial Auditorium, Sacramento, on October 3. Seated on the platform just behind the Governor is Mrs. Hideo Kodani of Pacific Palisades, general chairman.

More than 800 safety-minded Californians took part in the 1963 two-day Governor's Traffic Safety Conference which was held in Sacramento October 3-4.

After hearing an opening exhortation from Governor Edmund G. Brown to "probe for new approaches, new remedies, new programs," the participants concentrated on one or another of the 10 divisional fields of interest, with each division later reporting on its findings and recommendations at the luncheon which concluded the conference.

Other highlights of the conference included an opening-day luncheon at which President Howard Pyle of the National Safety Council commended California on winning the 1962 "Flame of Life" award for progress in traffic safety in this State; and a dinner meeting at which Assemblyman Richard Donovan of Chula Vista outlined recent legislative efforts.

The conference divisions were as follows: armed forces, citizen support, driver licensing, education, enforcement, engineering, fleet operations, judges and prosecutors, teenagers, and women's activities.

In his opening statement, Governor Brown emphasized that California's progress and recognition in traffic safety were not grounds for complacency.

He noted that the death rate in California traffic had been reduced from 6.4 persons killed per 100 million vehicle-miles of travel in 1956 to 5.2 per 100 MVM. He attributed much of this gain to the freeway construction program: "every day a life is spared and more than 65 persons are saved from injury by the safety factors built into California freeways."

"But there is no cause for pride," he continued, "in the shameful count of more than 11 dead and more than 500 injured every single day of 1963. We are still killing and injuring our people in traffic accidents that should not have happened."

The Governor announced that he was asking the Division of Highways to step up the installation of median barriers on freeways on a priority basis; the Department of Motor Vehicles to step up its driver improvement program with respect to negligent operators "and those drivers who may suffer from physical or mental disabilities"; and the Highway Patrol to use every officer with the greatest possible effectiveness—"preferably on the road."

He noted that efforts to require a chemical test for intoxication in drunk driving arrest cases did not succeed in the 1963 legislative session, and urged his audience to support this and other proposals by contacting their own legislators.

"Your legislators are men of good will," he said. "They will respond to your ideas and suggestions. This is political lobbying of the best kind."

SEATTLE PUBLIC LIBRARY
4TH & MADISON
SEATTLE 4, WASHINGTON

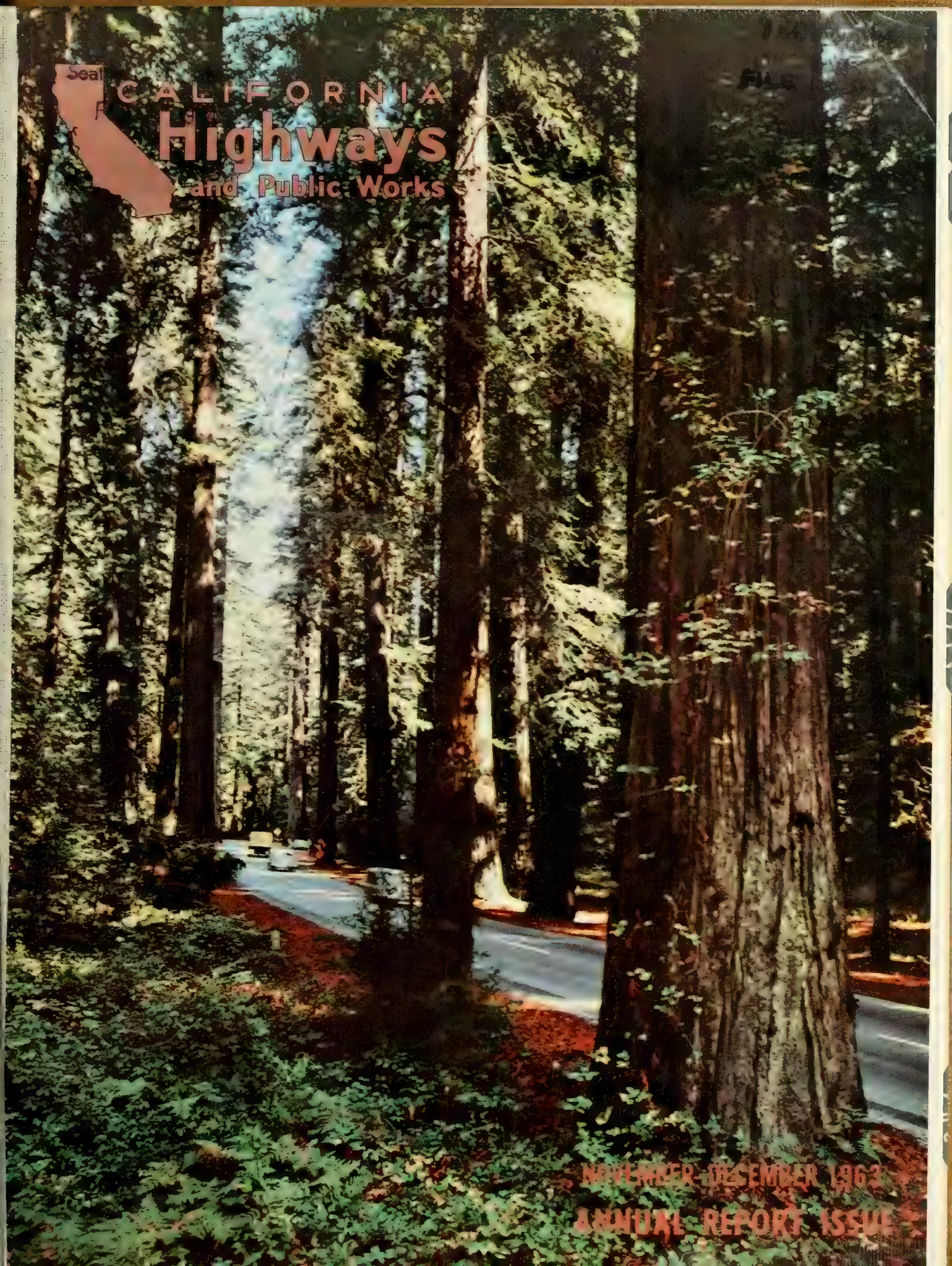
R56

California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

RETURN REQUESTED

BULK RATE
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152




CALIFORNIA
Highways
and Public Works
NOVEMBER-DECEMBER 1962
ANNUAL REPORT ISSUE

Letters of Transmittal

December 9, 1963

EDMUND G. BROWN
Governor of California

My dear Governor:

The 17th Annual Report of the Division of Highways, Department of Public Works, which I am pleased to submit to you, presents a broad picture of the state highway program during fiscal year 1962-63. It describes the steady progress in planning and constructing today for tomorrow's transportation needs, as well as the activities of the division's various units.

Your attention is invited to the comments contained in the enclosed letter of transmittal from the State Highway Engineer regarding progress on the interstate system and on the network of freeways and expressways envisioned by the Legislature's master plan.

The greatest benefit that Californians are receiving from freeway construction is increased traffic safety. More than one life was saved each day by freeways in service in 1961 and approximately 47,400 accidents and 23,800 injuries were prevented. As less than 10 percent of our ultimate freeway mileage was open to traffic at that time, subsequent years will show many times greater savings in life and limb.

Encouraging progress has been and is being made in co-operation between the State and local governments in highway planning. This co-operation has been furthered by provisions of the Federal-aid Highway Act of 1962, which requires highway projects in urban areas of 50,000 or more people to be based on a continuing, co-ordinated and comprehensive transportation plan to be eligible for federal funds after July 1, 1965.

Along with the spectacular progress in multilane freeway construction, there has continued an active, orderly program to widen roadways and bridges, ease curves, and provide "spot" correction of hazardous conditions so that every section of California benefits according to the most urgent needs and within the limits of available funds.

Respectfully,

JOHN ERRECA
Director of Public Works

December 9, 1963

JOHN ERRECA
Director of Public Works
State of California

Dear Sir:

In compliance with Section 143 of the Streets and Highways Code, the 17th Annual Report of the Division of Highways for the fiscal year ending June 30, 1963, is submitted herewith for your approval and transmittal to Governor Edmund G. Brown.

The report contains information on the construction program through the end of 1963 and a description of the projects in the budget for fiscal year 1964-65 which the California Highway Commission adopted in October.

The division is pleased to report that construction of California's share of the national system of interstate and defense highways is on schedule, except in San Francisco, and good progress is being made on the rest of the statewide network of freeways and expressways authorized by the Legislature in 1959.

The recent completion of intersecting and paralleling freeways in the Los Angeles area has offered motorists a choice of routes and relieved congestion on older freeways and traffic arterials.

The text portion of the report, with appropriate illustrations, is again published as the November-December issue of our bimonthly magazine, *California Highways and Public Works*. A supplement, available to interested persons on request, will contain financial statements, apportionment tables and contract statistics.

J. C. WOMACK
State Highway Engineer

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

Vol. 42 November-December Nos. 11-12



FRONT COVER—The section of U.S. 101 shown on the cover is a stretch of the Redwood Highway which has been included in the Avenue of the Giants since the photo was taken; the truck shown here is probably now using the new U.S. 101 freeway section across the Eel River, and the old two-lane highway (now State Highway 254) will be reserved for those who want to meander through the redwoods. (Photo by Pete Asano.)

BACK COVER—The Elysian Viaduct Bridge in Los Angeles, which carries a Golden State Freeway connection over the Pasadena Freeway, local city streets, railroad tracks, and the Los Angeles River, was given the award of merit by the American Institute of Steel Construction in 1963 for medium-span bridges with fixed spans under 400 feet and costing more than $500,000. (Photo by John Meyerpeter.)



CONTENTS

	Page
Departmental Organization Chart	2
California Highway Commission	3
California Highways—1963	5
Division Organization Chart	21
Operations	22
Construction	22
Maintenance	23
Materials and Research	28
Equipment	30
Administration	33
Office Engineer	33
City and County Projects	36
Service and Supply	38
Management Analysis	40
Systems Research	40
Planning	41
Advance Planning	41
Photogrammetric Mapping and Aerial Photography	42
Programs and Budgets	43
Design	44
Traffic	46
Urban Planning	48
Bridges	50
Bridge Planning	50
Bridge Operations	51
Special Studies	53
Bridge Office Engineering	54
Special Projects	55
State-owned Toll Bridges	55
Personnel and Information	58
Personnel	58
Training	59
Employee Safety	60
Audiovisual	61
Public Information	61
Right of Way	63
Legal	66
Fiscal Management	68
1964-65 Budget	70

LESTER S. KORITZ, *Editor*

STEWART MITCHELL, *Associate Editor* JOHN C. ROBINSON, *Associate Editor*

WILLIAM R. CHANEY, *Chief Photographer*

Editors are invited to use information contained herein and to request prints of any black and white photographs.

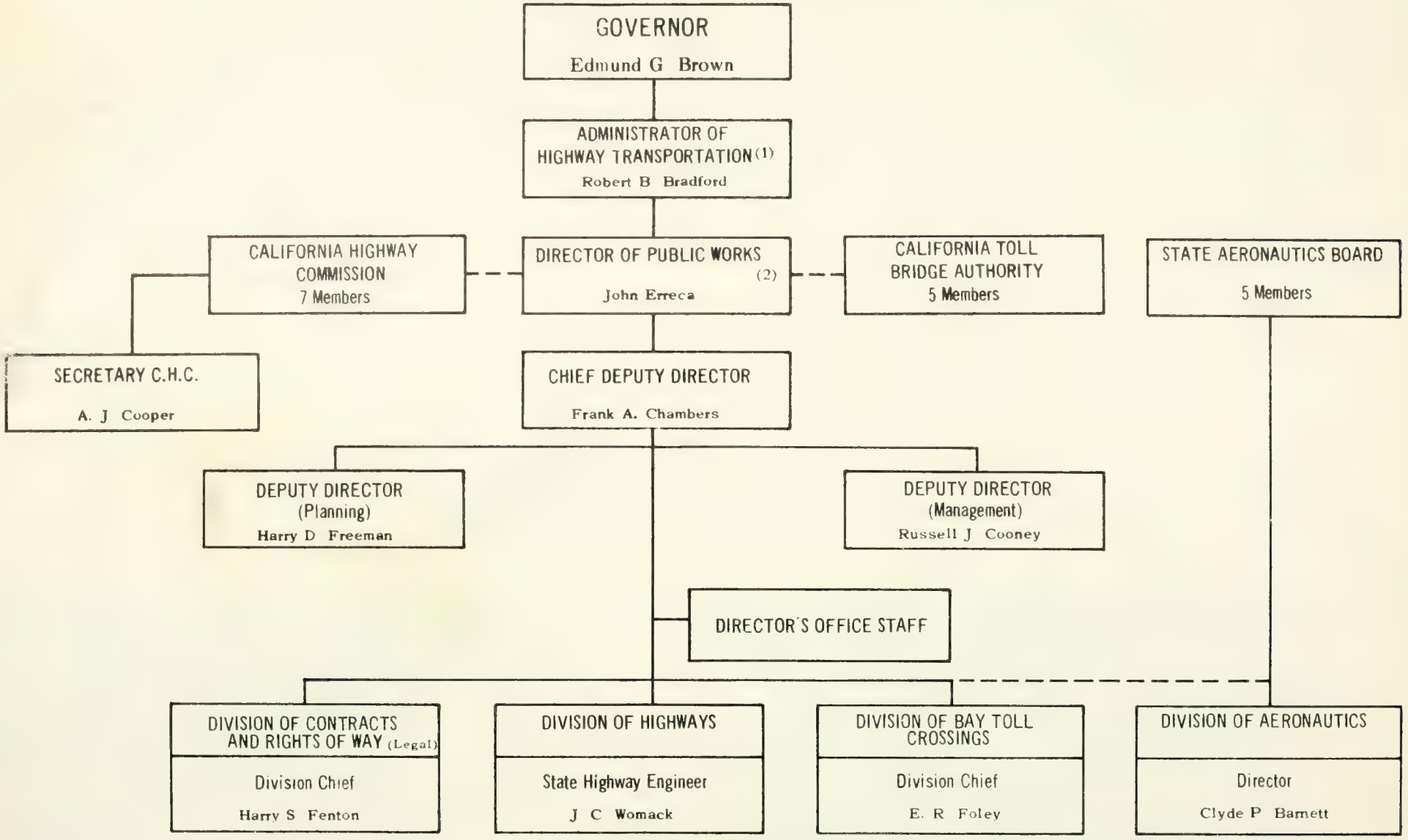
Address communications to: EDITOR,

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

P.O. Box 1499

SACRAMENTO, CALIFORNIA 95807

State of California
Department of Public Works -- Organization Chart



(1) Administrator is Ex-officio Chairman and Member of the California Highway Commission and a Member of the California Toll Bridge Authority

(2) Director is Ex-officio Administrative Officer of the California Highway Commission and Administrative Officer of the California Toll Bridge Authority

STATE OF CALIFORNIA—DEPARTMENT OF PUBLIC WORKS

CALIFORNIA HIGHWAY COMMISSION

ROBERT B. BRADFORD, Chairman, Ex Officio

Member	*Residence*	*Date of original Appointment*	*Term Expires*
JAMES A. GUTHRIE	San Bernardino	September 14, 1943	January 15, 1965
ARTHUR T. LUDDY	Sacramento	February 16, 1959	January 15, 1967
ROGER S. WOOLEY	San Diego	March 18, 1959	January 15, 1967
ABRAHAM KOFMAN	San Jose	September 14, 1961	January 15, 1964
FRANKLIN S. PAYNE	Los Angeles	February 3, 1962	January 15, 1966
WILLIAM S. WHITEHURST	Fresno	April 25, 1963	January 15, 1965

Executive Officer: JOHN ERRECA
Secretary: A. J. COOPER
Assistant Secretary: ROBERT T. MARTIN

CALENDAR OF MEETINGS

CALIFORNIA HIGHWAY COMMISSION

July 1, 1962, to June 30, 1963

July 24, 1962 ..... Los Angeles
(Public hearing, Road VII-LA-170-C,BwP,Irw, between San Bernardino Freeway (Route 26) and adopted Route 9 (Foothill) Freeway)

July 24, 1962 ..... Seal Beach
(Public hearing, Road VII-Ora,LA-170-A,S1B;A, between Bay Boulevard and San Diego Freeway (Route 158))

July 25, 1962 ..... Los Angeles

August 22 and 23, 1962 ..... Sacramento

September 19, 1962 ..... Thousand Oaks
(Public hearing, Road VII-Ven-155-B, between Route 2 (Ventura Freeway) and Tierra Rejada Road)

September 20, 1962 ..... San Diego

September 27, 1962 ..... Novato
(Public hearing, Road IV-Mrn-1-Nvto,A, between 0.8 mile north of Atherton Ave. and 0.3 mile south of Novato Creek)

October 17 and 18, 1962 ..... Eureka

October 19, 1962 ..... Sacramento

November 27 and 28, 1962 ..... Sacramento

November 28, 1962 ..... Williams
(Public hearing, Road III-Col-7-B,C, between Route 15 near Williams and the Colusa-Maxwell Road)

November 29, 1962 ..... Mill Valley
(Public hearing, Road IV-Mrn-56-A,B, between Route 1 and 2.8 miles south of Olema)

November 30, 1962 ..... San Bruno
(Public hearing, Road IV-SM-229-A,Pfa,SBr, between Sweeney Ridge and Route 68)

December 19, 1962 ..... Los Angeles
(Public hearing, Road VII-LA-162-LA, between Ardmore Avenue and Glendale Boulevard.)

December 20, 1962 ..... Los Angeles

December 21, 1962 ..... Los Angeles
Inspection of highways and opening of San Diego Freeway

Jan. 23 and 24, 1963 ..... Sacramento

Feb. 27 and 28, 1963 ..... Sacramento

March 14, 1963 ..... Santa Ana
(Public hearing, Road VII-Ora-60-B,NptB,A,HntB, between 2.2 miles south of MacArthur Boulevard (Legislative Route 184) and Beach Boulevard (Legislative Route 171))

March 26, 1963 ..... Sutter Creek
(Public hearing, Road X-Ama-65-B,StCk,Ana, between Route 34 at Martell and Route 54 at Central House)

March 27, 1963 ..... Sacramento

April 24, 1963 ..... Sacramento

May 22 and 23, 1963 ..... Sacramento

June 26 and 27, 1963 ..... Sacramento

PAST MEMBERS OF THE CALIFORNIA HIGHWAY COMMISSION

Name	Residence	Date of appointment	Termination of membership
Burton A. Towne*	Lodi	Aug. 2, 1911	Resigned Jan. 14, 1914
Charles D. Blaney*	Saratoga	Aug. 2, 1911	Resigned Mar. 1, 1917
N. D. Darlington*	Los Angeles	Aug. 2, 1911	Resigned Jan. 8, 1923
Charles F. Stern	Eureka	Jan. 15, 1914	Resigned Dec. 21, 1918
Henry J. Widenmann*	Vallejo	Mar. 1, 1917	Died Oct. 6, 1918
Charles A. Whitmore*	Visalia	Nov. 29, 1918	Resigned Jan. 8, 1923
Emmett Phillips*	Sacramento	Dec. 21, 1918	Died June 18, 1919
George C. Mansfield*	Oroville	June 24, 1919	Resigned Jan. 9, 1923
Harvey M. Toy*	San Francisco	Jan. 9, 1923	Resigned Jan. 3, 1927
Louis Everding*	Arcata	Jan. 9, 1923	Resigned Jan. 17, 1927
Nelson T. Edwards*	Orange	Jan. 10, 1923	Resigned Jan. 3, 1927
Ralph W. Bull*	Eureka	Jan. 6, 1927	Resigned Jan. 6, 1931
J. P. Baumgartner*	Santa Ana	Jan. 6, 1927	Resigned Jan. 6, 1931
M. B. Harris*	Fresno	April 18, 1927	Resigned Jan. 6, 1931
Joseph N. Schenck*	Los Angeles	Aug. 19, 1927	Resigned Jan. 6, 1931
Fred S. Moody*	San Francisco	Aug. 19, 1927	Resigned Jan. 6, 1931
Earl Lee Kelly*	Redding	Jan. 6, 1931	Died Nov. 1, 1962
Frank A. Tetley*	Riverside	Jan. 6, 1931	Resigned July 31, 1935
Timothy A. Reardon*	San Francisco	Jan. 6, 1931	Resigned May 7, 1936
Harry A. Hopkins*	Taft	Jan. 6, 1931	Resigned Oct. 14, 1937
Philip A. Stanton*	Anaheim	Jan. 6, 1931	Resigned Mar. 3, 1939
Dr. W. W. Barham	Yreka	Dec. 20, 1932	Resigned May 21, 1935
Ray Ingels	Ukiah	May 21, 1935	Resigned Oct. 4, 1935
C. D. Hamilton*	Banning	Aug. 1, 1935	Died April 24, 1936
H. R. Judah*	Santa Cruz	May 7, 1936	Resigned Oct. 5, 1937
Paul G. Jasper*	Fortuna	May 7, 1936	Resigned Mar. 3, 1939
William T. Hart*	Carlsbad	July 7, 1936	Resigned Mar. 3, 1939
Robert S. Redington	Los Angeles	Oct. 5, 1937	Resigned Jan. 27, 1939
Frank W. Clark	Los Angeles	Jan. 27, 1939	Resigned Mar. 10, 1939
Lawrence Barrett	San Francisco	Mar. 3, 1939	Resigned Jan. 11, 1943
Iener W. Nielsen	Fresno	Mar. 3, 1939	Resigned Jan. 11, 1943
Amerigo Bozzani	Los Angeles	Mar. 3, 1939	Resigned Jan. 11, 1943
Bert L. Vaughn	Jacumba	Mar. 3, 1939	Resigned Jan. 11, 1943
L. G. Hitchcock	Santa Rosa	Mar. 10, 1939	Resigned Jan. 11, 1943
Gordon H. Garland†	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
Mrs. Dora Shaw Heffner†	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
Miss Helen MacGregor†	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
Verne Scoggins†	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
William Sweigert†	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
C. Arnholt Smith	San Diego	Sept. 14, 1943	Resigned Jan. 1, 1949
C. H. Purcell*	Sacramento	Sept. 14, 1943	Resigned July 31, 1951
Homer P. Brown*	Placerville	Sept. 14, 1943	Resigned Oct. 26, 1951
Harrison R. Baker	Pasadena	Sept. 14, 1943	Jan. 15, 1954
Charles T. Leigh	San Diego	May 11, 1949	Jan. 15, 1955
F. Walter Sandelin	Ukiah	Sept. 14, 1943	Jan. 15, 1956
Frank B. Durkee	Sacramento	Aug. 4, 1951	Resigned Dec. 31, 1957
H. Stephen Chase	San Francisco	Oct. 30, 1951	Resigned Feb. 25, 1958
Fred W. Speers	Escondido	Jan. 21, 1955	Jan. 15, 1959
C. M. Gilliss	Sacramento	Jan. 1, 1958	Resigned Nov. 10, 1958
John O. Bronson	Sacramento	Feb. 26, 1958	Jan. 15, 1959
T. Fred Bagshaw	Mill Valley	Nov. 10, 1958	Resigned Jan. 4, 1959
Robert L. Bishop	Santa Rosa	Jan. 15, 1956	Jan. 15, 1960
Chester H. Warlow*	Fresno	Sept. 14, 1943	Jan. 15, 1961
John J. Purchio	Hayward	Jan. 15, 1960	Resigned Sept. 9, 1961
Robert E. McClure	Santa Monica	Jan. 18, 1954	Jan. 15, 1962
John Erreca	Los Banos	Jan. 16, 1961	Sept. 20, 1963

* Deceased.
† Member of the Interim Commission.



The curving ramps at center and right of photo connect the San Diego Freeway Interstate 5 now opened to traffic between Palm and 28th Streets in San Diego and under construction through National City, with the SSR 94 Freeway (foreground). The latter route connects with the F and G Street one-way couplet in the city's business district (background).

California Highways...1963

Paradoxically, although California's rapid growth will cause the number of registered motor vehicles to double by 1980 and the motor vehicle miles traveled to increase from a current 70 billion to 200 billion a year, highway engineers are confident that there will be less traffic congestion then than exists today.

This confidence is based on the sound financing of the highway construction program which permits orderly planning, on the tested procedures for adopting highway routes, and on the master plan enacted in 1959 for the construction of a 12,414-mile, $10,500,000,000 freeway and expressway system by 1980—all provided by the people of California through their Legislature.

Conventional highways are in time choked by the encroachments of roadside strip developments that slow traffic, and the high rate of turning movements and vehicles moving at random from the sides of the road multiply accident potentials on these roads.

Access to and exit from freeways and expressways, on the other hand, are limited to certain strategic points where traffic can enter or leave safely. Free from encroachments along their routes, their carrying capacity and safety benefits are permanent.

The word "freeway" signifies a controlled-access highway that is free of traffic lights and stop signs, left turn movements across oncoming traffic and intersections at grade.

Legally, expressways are classified as freeways as access to them is controlled. However, they may have some crossings at grade, with channelization to permit left turn movements.

Both freeways and multilane expressways are divided by median strips of varying widths.

As conventional highways are superseded by a network of interchanging and paralleling freeways and expressways, a network that will constitute only 10 percent of the total road mileage but will carry 60 percent of all the State's traffic—leaving the remaining 90 percent of the mileage composed of streets, county roads and highways to carry only 40 percent of the traffic – congestion lessens and travel time is shortened.

This section of Interstate 5 Freeway in Shasta County between Shotgun Creek and Castella was completed in March. Its rolling curves and gentle grades blend with the natural surroundings along this scenic but high-speed route.



The Master Plan

The freeway and expressway system envisioned by the master plan will connect all cities of 5,000 or more people, and will serve every major industrial, agricultural, commercial and recreational region when completed in 1980. Its construction is a necessity if California is to continue to prosper.

The Legislature has provided for periodic review of the system to determine if additions, deletions or revisions should be made because of changing traffic requirements. Such a review will be submitted early in 1965.

At year's end, of the 2,742 miles of multilane divided highways opened to traffic, 1,352 miles were constructed to full freeway and 761 miles to expressway standards. Another 595 miles of freeways and 61 miles of expressways are under construction or budg-



The Vincent Thomas Bridge was opened to traffic in mid-November between San Pedro in Los Angeles and Terminal Island. It is Southern California's first major, high-level suspension span and cost $21,000,000.

eted. (Expressway mileage was 833 a year ago. It is shrinking as many sections are progressively converted to full freeway.)

Additionally, 798 miles of two-lane expressways, mostly in rural and mountain areas, are opened to traffic, under construction or budgeted. Sufficient rights-of-way have been obtained to permit widening to four lanes when traffic volumes warrant and funds are available.

While particular attention is devoted to access-controlled types of highways, work continues to alleviate deficiencies on all state routes. Roads are being widened, resurfaced and realigned to ease curves. The entire highway program is balanced to benefit each area of the State.

Interstate System

The 41,000-mile National System of Interstate and Defense Highways, commonly referred to as the interstate system, is the largest construction project in history. When completed in 1972, it will link the principal metropolitan areas and industrial centers of all the states except Hawaii and Alaska by high-speed, ultrasafe freeways.

Of the 2,177 miles of interstate routes authorized for California, locations for all but 33 miles have been adopted. A total of 576 miles are now completed and another 394 miles are under construction or budgeted. An additional 217 miles of interstate routes are in operation as expressways but will be upgraded to full freeway standards by 1972.

Because this State concentrated its early interstate freeway efforts in urban areas where traffic needs are greatest but where each mile is more difficult and costly to construct, California's mileage completed may not seem impressive. However, this State leads the nation in the amount of funds expended, obligated or budgeted, and is among the leaders in the amount of rights-of-way purchased.

California's interstate freeway mileage, all of which is included in the freeway and expressway system referred to previously, will cost nearly $3,550,000,000. Counting projects in the budget for fiscal year 1964-65, a total of $1,970,000,000 has been spent, obligated or budgeted to date.

Traffic Safety

The most important benefit that the public receives from modern freeways is improved safety. Carefully kept statistics over the past 14 years covering billions of miles of travel prove conclusively that freeways are much safer than their conventional counterparts in both rural and urban areas.

An examination of the causes of accidents and the design characteristics of freeways that differentiate them from conventional highways reveals the freeway's built-in safety features.

Head-on, right-angle, and many other collisions, also accidents involving pedestrians, are eliminated by the freeway's divider strips and median barriers between opposing lanes of traffic; by its elimination of crossings at grade and movements to and from driveways and parking spaces; by its provision of acceleration and deceleration lanes that permit vehicles to enter or leave the freeway without endangering following cars; and by its fencing which limits pedestrian crossing to overpasses.

More than 130 accidents and 65 injuries were prevented and almost one life was saved each day during 1961 by California freeways. Using the California Traffic Safety Foundation's values for accidents, California freeways saved the motorist over $65,000,000 that year.

The U.S. Bureau of Public Roads recently compared fatality rates on 1,130 miles of modern interstate freeways with those of the older highways in the same traffic corridors and concluded that the 41,000-mile interstate freeway system will save an estimated 8,000 lives each year when completed.

Other User Benefits

To these savings in deaths, injuries and property damage should be added the savings in pain, lost man-hours of employment, lower insurance rates, fuel and equipment costs and tremendous savings in travel time.

The 5.8 billion motor vehicle-miles driven on freeways in the Los Angeles area alone (Los Angeles, Orange and Ventura Counties) in 1962 resulted in estimated savings of $63,000,000 in

vehicle operating costs, $12,000,000 from prevented accidents, and $221,000,000 in lessened travel time.

The time savings offered by freeways are particularly important in commercial operations. Each day, 48,000 tons of goods, the equivalent of 800 60-ton railroad boxcars, are transported over the Hollywood Freeway west of the four-level interchange. Similar tonnages are carried on sections of the San Bernardino, Santa Ana and Harbor Freeways. Lower equipment and labor costs to shippers are reflected in lower prices to consumers.

Motorbuses not only use freeways in intercity travel; they also take advantage of freeways in metropolitan areas to provide a form of mass transit. Also, the running time of buses using city streets is reduced as other traffic is diverted to the new freeway facilities.

Community Benefits

Traditionally, towns and cities developed along railroads and highways, with the latter frequently the principal streets. As the highways became increasingly congested, they tended to divide the communities through which they ran and diminished the importance of the retail establishments along their routes.

When through traffic is diverted to freeways that either bypass or traverse the communities on new alignment, the former wall of traffic is removed and, with ample parking again available to local shoppers, "Main Street" is revitalized, and everyone benefits from the elimination of annoying traffic noise and gasoline fumes that resulted from stop-and-go driving.

Industry today is moving away from central city districts to suburbia and beyond. Manufacturers want the advantages of cheaper land for their modern one-level plants. They locate in and pay taxes to communities served by modern freeways for the faster and cheaper movement of supplies and products, for the greater area that can be served by a central warehouse, and for the wider labor market upon which to draw.

The expanded commuting radius offers workers in such communities greater employment possibilties.



Five lanes of traffic on the upper deck of the San Francisco-Oakland Bay Bridge head west for the City by the Golden Gate following the shift to one-way operation on the bridge in October. Four years and $35,000,000 were needed for the extensive reconstruction of the structure by the Division of Bay Toll Crossings that made the change in traffic flow possible.

Those residents displaced by freeway construction are paid in cash for their properties and, for the most part, purchase better quarters in the same neighborhood.

Studies made by the Research and Development Section of the Right of Way Department, Division of Highways, confirm similar studies made by the U.S. Department of Commerce nationally. Both reveal but minor differences in the sale prices of homes adjacent to modern landscaped freeways and for homes a few blocks away. In many instances, the freeways have increased the values.

The Highway Team

The State Legislature must be regarded as the captain of the highway team composed of itself, the California Highway Commission and the Division of Highways.

Over the years, successive Legislatures have determined that the highway construction program should be financed by highway-user taxes on a pay-as-you-go basis; have created the California Highway Commission and delegated to it the responsibility of allocating funds to particular highway projects; have charged the commission with determining specific highway routings between termini which it, the Legislature, designates; and have created the master plan for the freeway and expressway system.

California's laws and practices governing the entire highway program are frequent subjects of study by highway organizations in other states and foreign countries.

The California Highway Commission

The Highway Commission was created in its present form to provide continuity in highway policy and to remove decisions on highway improvement from sectional and political considerations.

The members of the Highway Commission are appointed by the Governor and confirmed by the State Senate. Six of them are business and professional men who serve without pay for four-year staggered terms. Each is instructed by law to represent the State as a whole rather than particular cities or areas.

The Administrator of the Highway Transportation Agency serves as the commission's ex officio chairman, and the State Director of Public Works acts as its executive officer.

Commission members approve county primary road systems, authorize condemnation proceedings, execute deeds and right-of-way relinquishments and abandonments, as well as budgeting highway funds and adopting freeway and highway routes.

Not only does the commission make an annual budget each October for the coming fiscal year, but to insure that all savings from individual projects can be made available quickly for other jobs, adjusts budgeted amounts each month.

The Division of Highways

A unit of the Department of Public Works, the State Division of Highways is charged with the actual operation of the highway program including planning, design, right-of-way acquisition, construction and maintenance.

It is an organization of career civil servants chosen on the basis of competitive civil service examinations, and headed by the State Highway Engineer.

He, in turn, is assisted by a headquarters staff in Sacramento, and by engineers in charge of each of the State's 11 highway districts who are responsible for all phases of the highway program in their areas.

This decentralization insures the program's responsiveness to local conditions and needs.

Information on local highway matters may best be obtained from the following:

District I —Sam Helwer, District Engineer, 430 West Wabash Avenue, Eureka

District II —H. S. Miles, District Engineer, 1657 Riverside Drive, Redding

District III —Alan S. Hart, Assistant State Highway Engineer, 703 B Street, Marysville

District IV —J. P. Sinclair, Assistant State Highway Engineer, 150 Oak Street, San Francisco

District V —R. J. Datel, District Engineer, 50 Higuera Street, San Luis Obispo

District VI —W. L. Welch, District Engineer, 1352 West Olive Avenue, Fresno

District VII —E. T. Telford, Metropolitan District Engineer, 120 South Spring Street, Los Angeles

District VIII—C. V. Kane, District Engineer, 247 Third Street, San Bernardino

District IX —C. A. Shervington, District Engineer, South Main Street, Bishop

District X —J. G. Meyer, District Engineer, 1976 East Charter Way, Stockton

District XI —J. Dekema, Assistant State Highway Engineer, 4075 Taylor Street, San Diego

Highway Financing

It is axiomatic in highway construction that sound programming depends upon sound financing.

Major freeway projects in metropolitan areas, for example, require a minimum of four to six years from the beginning of route studies to the start of construction. Since the planning program must schedule the acquisition of rights-of-way and construction dates for specific projects, planners must be certain that sufficient revenue will be forthcoming.

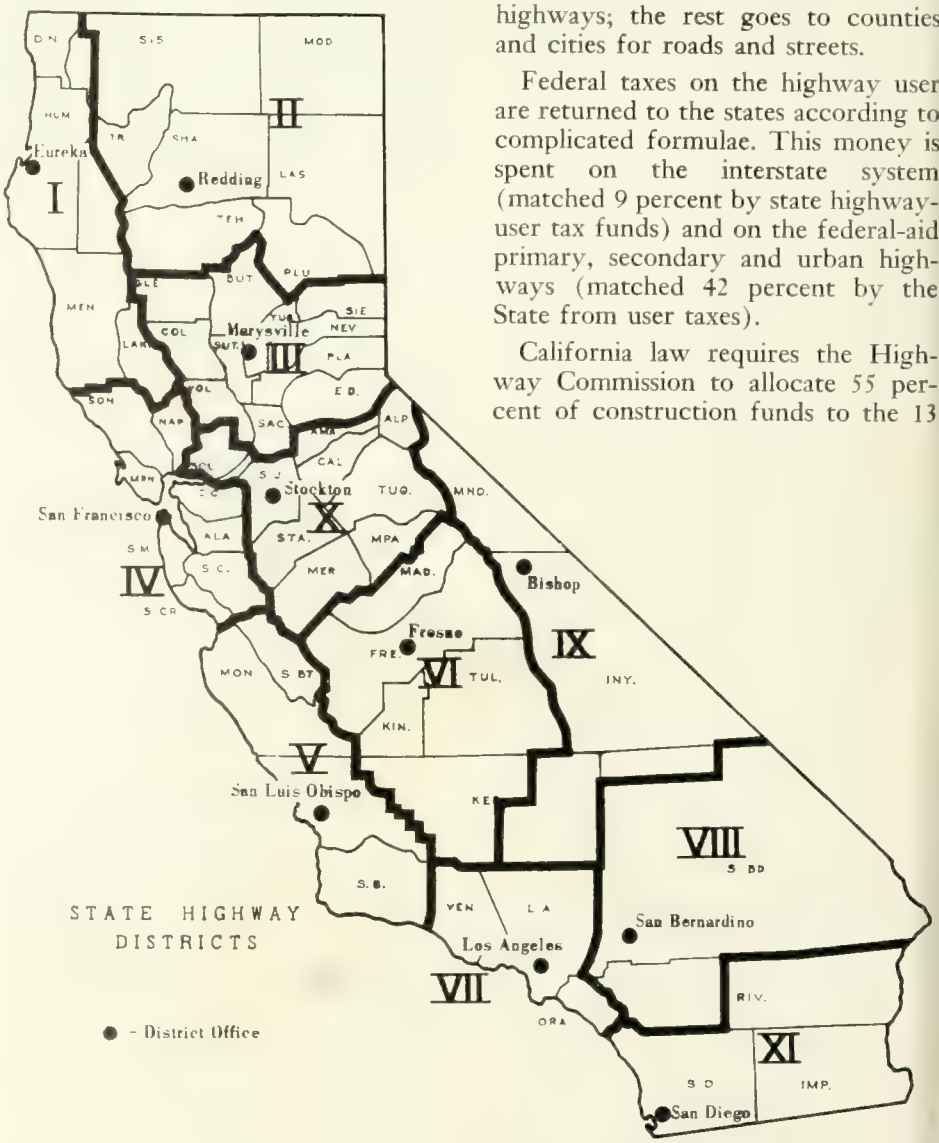
Fortunately, California's highway program is based on pay-as-you-go highway-user taxes on such fairly predictable items as gasoline and diesel fuel consumption, drivers' licensing and registration fees, weight fees on commercial vehicles, and taxes on for-hire trucking.

The State Constitution requires that all revenues so produced be spent for road construction and maintenance and for the administration of the Division of Highways, the Department of Motor Vehicles and the Highway Patrol. They may not be diverted for other purposes.

The state tax on gasoline is the largest revenue source. It was increased this year from 6 to 7 cents per gallon. Of this, 3.61 cents are spent on construction and maintenance of state highways; the rest goes to counties and cities for roads and streets.

Federal taxes on the highway user are returned to the states according to complicated formulae. This money is spent on the interstate system (matched 9 percent by state highway-user tax funds) and on the federal-aid primary, secondary and urban highways (matched 42 percent by the State from user taxes).

California law requires the Highway Commission to allocate 55 percent of construction funds to the 13



southern counties and 45 percent to the remaining 45 counties. It further requires the expenditure of certain minimums in each of the 11 highway districts, and a minimum of $4,000,000 in each county other than sparsely populated Alpine and Sierra over each four-year period. These two counties must be allocated $1,000,000 in highway projects as four-year minimums.

The law permits the commission, however, to spend 30 percent of total construction funds at its discretion within the 55-45 restriction. This insures the financial flexibility essential to meet requirements caused by lead time and other factors and the various controls imposed by state and federal law.

Because California's well-established long-range highway planning program results in sufficient projects being brought through the stages of route determination, freeway agreement, right-of-way acquisition, and the preparation of plans and specifications, no delay occurs in obligating available funds.

Freeway Route Selection

Although the Legislature designates the termini of all state highways and may specify certain control points through which they must pass, it has charged the Highway Commission with determining the specific routings.

The governing bodies of cities and counties are notified by the appropriate highway district at the initiation of studies leading to freeway construction, and their co-operation is requested to insure that the studies consider the area's master plan for transportation and development.

This policy of many years' standing puts this State in good position to comply with the Federal Aid Highway Act of 1962 which requires highway projects in urban areas of 50,000 or more people to be based on continuing, co-ordinated and comprehensive transportation planning procedures to be eligible for federal funds after July 1, 1965.

Several alternate routes are developed. Each is considered in relationship to the origins and destinations of traffic, community plans for land use, the engineering controls imposed by the area's geography, right-of-way and construction cost factors, the number of homes or businesses each would take, effects upon the area's economy, and the social impact of each upon community values.



The widening of Tiburon Boulevard (SHR 52) in Marin County typifies continuing attention to conventional highways.

Utility and transportation companies, water and school districts, and interested agencies of federal, state and local governments are consulted. The alternate routes are mapped and thoroughly analyzed prior to well publicized public hearings at which the studies are explained and area residents are urged to express their views.

The district engineer forwards the completed study, including hearing transcripts, to the State Highway Engineer, who, in turn, recommends a routing to the Highway Commission.

The commission informs the local governing body of its intention to adopt a route and asks if a public hearing by the commission members is desired. Such a request is always granted. Occasionally, the commission will decide that the public interest requires such a hearing even though no request is made.

Finally, the commission weighs the merits and defects of each alternate and adopts the routing which appears to serve the greatest public interest.

Every effort is made throughout the route selection process to consider and protect the views and rights of all—property owners, local merchants, civic planners, and, among others, the motorists who will use the new facility.

Route selection is followed by conferences between Division of Highways personnel and the local govern-



Shown is a portion of the 14.4-mile section of the Antelope Valley Freeway in northern Los Angeles County which was opened to traffic in October.

ing body to negotiate a freeway agreement covering local street and road adjustments. The local government thus joins the team which decides the types and locations of interchanges and traffic separation structures.

Right of Way Acquisition

When design studies are sufficiently advanced as to identify properties in the path of the freeway's construction, agents of the Right of Way Department visit affected residents and explain acquisition procedures.

This is done as early as possible before the properties will be required to permit those affected to plan intelligently. Adequate time always exists between route adoption and property acquisition to prevent serious inconvenience.

Skilled appraisers, who in truth work jointly for the State and for the property owners as shareholders in the State, establish the price the State should pay. Their reports are reviewed and approved and owners are offered fair market value for their holdings. The courts have defined fair market value as "the highest price in terms of money which the land (property) will bring if exposed for sale in the open market with a reasonable time to find a purchaser, buying with full knowledge of all the uses and purposes to which it is adapted and for which it is capable of being used."

The "fair market value" appraisal is based on trained judgment. It is completely uninfluenced by an owner's bargaining skill.

The fairness of the state appraisers is attested to by the fact that although the Right of Way Department acquired 8,116 properties for highway construction last fiscal year, 96.8 percent of the transactions were settled amicably. Only 3.2 percent were acquired by court action in eminent domain proceedings.

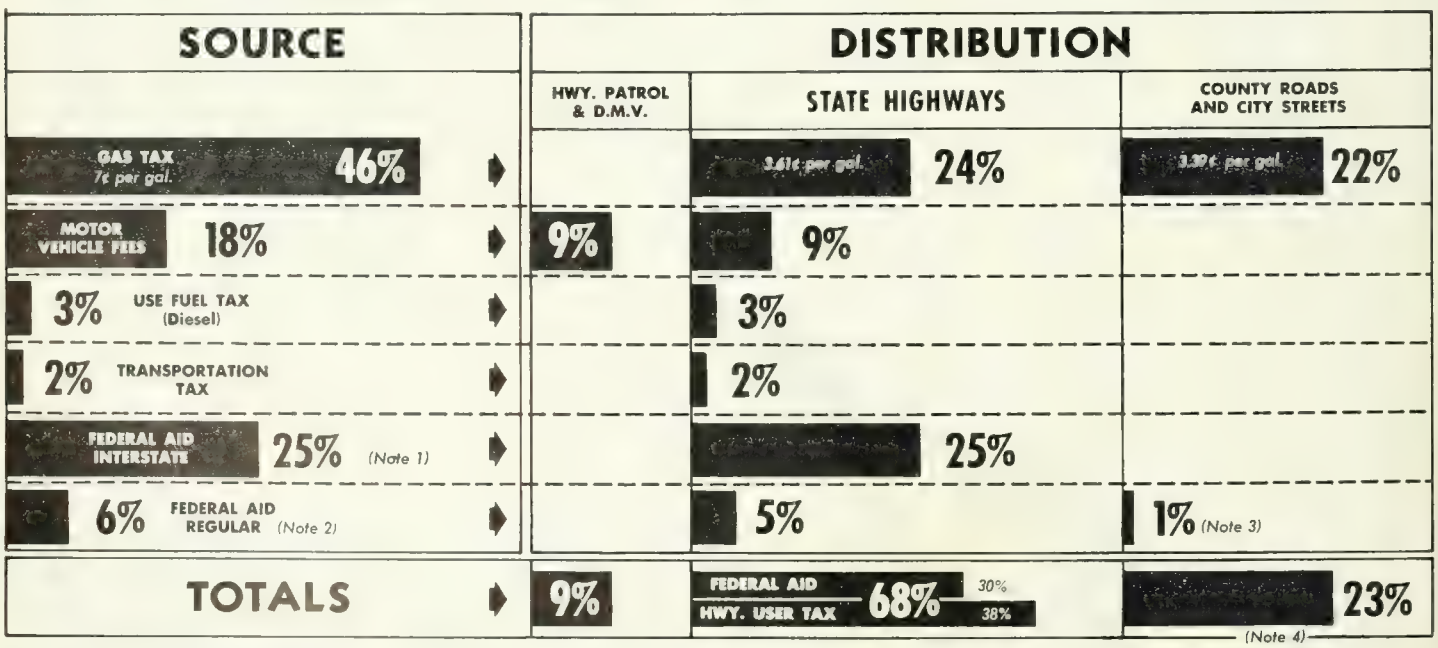
The Right of Way staff in each highway district office is ready and able to advise and assist people displaced by freeway construction to purchase or rent the type of dwelling they desire and can afford.

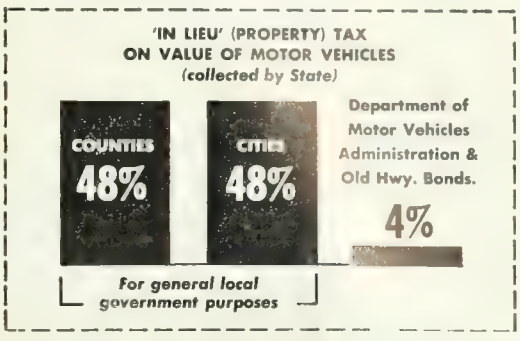
Among the advantages owners discover in selling to the State rather than a private buyer are: Payment is made in cash; no real estate commission is deducted; the State pays all title costs and document fees; the U.S. Internal Revenue Department does not require income or capital gains taxes on the increase in the sale price over the original cost when property

Highway User Taxes Including Federal Aid

Percentages based generally on 1964-65 Budget.

State of California
Department of Public Works
Division of Highways





NOTES:

1. *Federal Aid Interstate must be matched 9% by State funds from above sources.*
2. *Federal Aid Primary, Secondary, and Urban must be matched 42%, mostly by State funds from above sources.*
3. *Federal Aid Secondary Funds for county roads do not include matching funds, up to $100,000 per county per year, from State Highway Fund.*
4. *Does not include $5,000,000 per year State highway matching funds for local railroad grade separations, or about $3,000,000 a year for urban extension of F.A.S. county roads.*

is sold to a governmental agency for public purposes, provided that the money received is used to purchase a similar property within certain time limits; loans from the U.S. Veterans Administration and the California Department of Veterans' Affairs may be transferred for coverage on another property.

Highway Aesthetics

Reflecting the determination of state officials and residents to preserve California's natural beauty against the onslaughts of a rapid population and industrial growth, the Legislature at its last session passed Senate Bill 1467 which created an advisory committee to recommend standards for a statewide scenic highway system on portions of existing and future state highway routes.

This new law was the outgrowth of preliminary and final reports submitted to the Legislature in March of 1962 and 1963, prepared under the administrative direction of the Department of Public Works by an interdepartmental group and a citizens advisory committee.



Fresno residents examine large-scale maps of proposed alternate freeway routes and ask questions of the engineers prior to a public hearing conducted by the district office of the Division of Highways at the Fresno Memorial Auditorium last May.

Thirteen well-publicized regional workshop sessions organized by the Division of Highways in co-operation with the above groups were held with local officials and citizens to test the preliminary report's recommendations against local knowledge and desires. These meetings not only helped to appraise criteria for the scenic highway concept, but also communicated wider understanding of the proposed program.

The execution of the approximately 5,000-mile scenic highway system depends on both the preservation of the scenic corridors through which the highways pass and special attention to the highways' visual appearance and impact on the landscape.

The Division of Highways has the main responsibility for effecting those planning and design standards adopted for scenic highways.

Local governments, through zoning ordinances, and the State, acting through the Department of Parks and Recreation and with the advice of the Office of Planning, will share the responsibility for planning the preservation of the scenic appearance of the landscape outside the highways' right-of-way viewed by the passing motorist.

Senate Bill 173, enacted at the same session and based on a report pre-

FREEWAYS and SAFETY

(1961 - 62 AVERAGES)

*** ACCIDENT RATE PER MILLION VEHICLE MILES**

RURAL FREEWAYS	1.185
RURAL CONVENTIONAL HIGHWAYS	2.470
URBAN FREEWAYS	1.540
URBAN CONVENTIONAL HIGHWAYS	5.225

*** FATALITY RATE PER 100 MILLION VEHICLE MILES**

RURAL FREEWAYS	4.385
RURAL CONVENTIONAL HIGHWAYS	9.165
URBAN FREEWAYS	2.395
URBAN CONVENTIONAL HIGHWAYS	3.245





The new Vista Point parking area at the north end of the Golden Gate Bridge, which affords a spectacular view of San Francisco (above), and new safety rest areas on the Interstate 15 Freeway in the Mountain Pass area of San Bernardino County near the Nevada line (right), reflect increased services to the motorist.

pared by the Division of Highways, authorized an eventual total of 250 safety roadside rests along state highways at approximate half-hour normal driving time intervals, and at highway entrances to large metropolitan areas for map inspection purposes.

It also transferred responsibility for maintaining 10 existing roadside rests from the Division of Beaches and Parks to the Division of Highways.

The safety rest area program will cost an estimated $5,845,000 to construct and approximately $1,164,000 each year to maintain.

Both roadside rest and scenic highways policies are incorporated in Senate Bill 581, passed in the last session, which deals specifically with the Westside Freeway (Interstate 5), with provision for co-ordinating the activities of several state agencies in developing both the highway and adjacent facilities.

The concern of the Division of Highways for the aesthetic appearance of its routes has long been evidenced by its landscaping of freeway sections in urban areas, its functional and tree planting program, its treatment of cut slopes and its design of structures.

In the past fiscal year, the division installed 184,350 trees and shrubs and 5,648,000 ground cover plants along its highways at a cost of $4,111,252.

The functional planting program, though intended primarily for erosion and fire control, the delineation of curves and structures, and the reduction of traffic noise and headlight glare, provides improvement in attractiveness as a secondary benefit.

The tree-planting program replaces trees removed by highway construction and improves the appearance of highways in areas where more costly landscaping and planting cannot be justified.

Maintaining existing landscaping and controlling roadside vegetation cost more than $5,400,000 last fiscal year. Approximately $1,500,000 was spent on the removal of litter.

Contract Data

During the 1962-63 fiscal year, the Division of Highways opened bids on 508 projects with an estimated construction value of $352,786,700, including construction engineering. Contracts valued at $313,724,400 were awarded for 486 of these projects, and all bids for 13 projects were rejected as not in the best interests of the State. Contracts for the remaining nine projects were awarded after the close of the fiscal year.

Bids received in the previous fiscal year resulted in the award of an additional 15 contracts valued at $2,270,600.

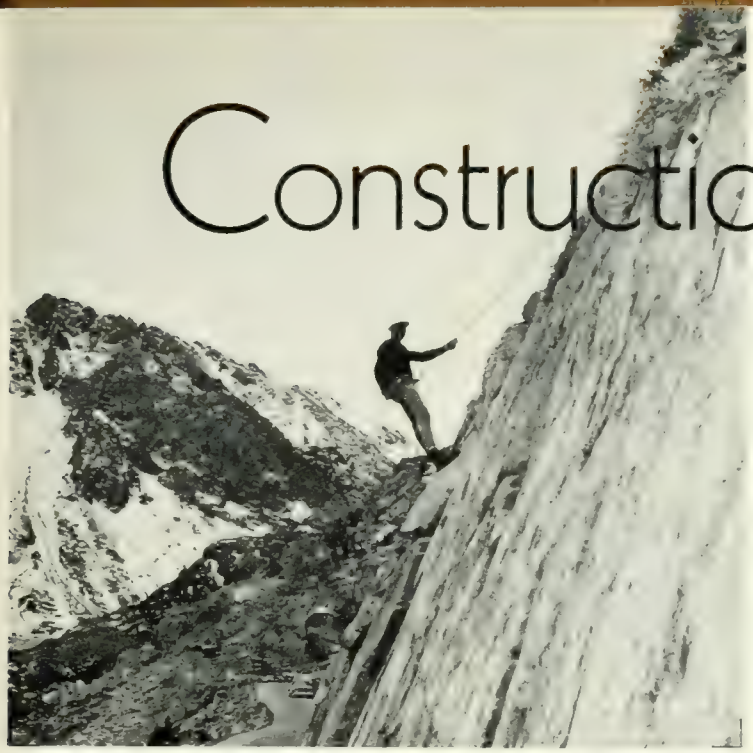
The year's cost for right-of-way acquisition and utility relocation, exclusive of land clearance, overhead, and acquisition for other agencies, amounted to approximately $160,600,000.

The total of $315,995,000 in contracts awarded in the fiscal year was composed of $280,241,700 for construction on state highways; $14,949,300 for work on county roads, including the Federal Aid Secondary System; and $20,804,000 for maintenance and emergency repairs and work for other agencies.

The contracts totalling $280,241,700 for work on state highways employed $216,724,100 from the 1962-63 budget, and $63,517,600 from the budget for 1963-64. Statutory provisions permit the award of contracts financed by funds in the budget for the following fiscal year as early as January 1, six months before the fiscal year begins.

The contracted state highway work involved improvement of 1,427 miles of highways and construction of 506 bridges and separation structures.

Construction Progress



The highway employee scaling the cliff to place construction stakes for the SSR 120 (Tioga Pass) construction job was specially trained for such climbing by the Marine Corps Mountain Warfare Training Center in Mono County.

California's highway construction program in 1963 included such major and costly projects as the completion of the Vincent Thomas Bridge between San Pedro in Los Angeles and Terminal Island, the Webster Street Tube under the estuary separating the Cities of Oakland and Alameda, and the Randolph Collier Tunnel on US 199 through Oregon Mountain.

Continued progress was made in constructing interstate and other freeway sections and in upgrading the standards of existing freeways and expressways by adding lanes or by eliminating intersections at grade.

Of equal importance to the motorists affected, however, curves were eased on conventional highways, roads were widened, channelization was installed where needed, and travel in remote rural areas was made more safe and convenient.

The program was balanced, not only geographically, but between relieving present deficiencies and constructing for tomorrow's needs.

At the last session of the Legislature, a bill was passed which renumbers the state highway routes effective July 1, 1964. Projects on the following pages are listed by both old and new route designations. If only one route number appears, it will not change.

San Diego and Imperial Counties

The future San Diego Freeway (Interstate 5), presently in operation between Palm and 28th Streets in San Diego, will be opened to traffic through National City to connect to the Montgomery Freeway next spring. A project is being advertised for bids for a connection to the Washington Street Interchange, and funds have been budgeted for a northerly extension of the freeway to Rosecrans Street.

Three contracts have been completed on Interstate 5 in the north San Diego County area, including substantial fills in several unstable lagoon areas. Two major projects are underway and nearly $19,000,000 have been allocated to construct another 12.5 miles of this critical route to full freeway standards at several locations between Balboa Avenue in San Diego and five miles north of San Marcos Road in Encinitas.

Construction completed last February added five miles to the SSR 78 Freeway east of Vista, and a project is underway on this route to extend the freeway to U.S. 395 in Escondido, completing a freeway and expressway facility eastward from Interstate 5 in Oceanside.

Work is progressing rapidly on a contract to provide a full freeway segment on U.S. 395 near Poway Road, with an interchange at this high-volume critical intersection. The four-lane full freeway will extend 1.4 miles north and 2.2 miles south of the Poway Road Interchange. Funds have been budgeted to continue this four-lane section southerly two miles to connect to the existing four-lane facility near Miramar Road. Four miles of four-lane expressway are budgeted on U.S. 395 north and south of Escondido.

The new budget also provides funds for 1.7 miles of SSR 67 Freeway north of Interstate 8 near Santee.

A four-mile freeway contract on Interstate 8 east of El Cajon was awarded last fall. A project included in the new budget will extend it farther east to the vicinity of Harbison Canyon Road west of Alpine, providing 24 miles of continuous full freeway from Pacific Highway in San Diego.

Farther east on Interstate 8, 10 miles of west bound freeway lanes in the Mountain Springs area near the San Diego-Imperial county line were opened to traffic in early December and work is underway on the eastbound lanes.

In Imperial County, the 1964-65 budget provides for construction of an expressway on U.S. 99-SSR 111 (new SSR 111) between the north city limit of Calexico and the junction of the future Interstate 8 Freeway. The existing roadway will be widened and resurfaced north of this junction to existing U.S. 80.

San Bernardino and Riverside Counties

Construction is underway on a 45-mile section of Interstate 15 Freeway between Yermo and Cronese Valley in San Bernardino County, and a project included in the new budget will extend the freeway 18 miles to east of Baker. A 23-mile section extending to the Nevada line was completed in October.



Ten miles of the westbound lanes (lower level) of the Interstate 8 Freeway in the Mountain Springs area near the San Diego-Imperial county line were opened to traffic in December. Work continues on the eastbound lanes.

These three projects, totalling more than $25,500,000, will provide a continuous freeway between the Nevada line and Barstow and freeway and expressway southwesterly to San Bernardino.

Another 6.7-mile section of this route has been budgeted for conversion from expressway to freeway in and near Victorville.

A project to construct nine miles of Interstate 40 Freeway southeast of Barstow has been advertised for bids and the new budget will finance California's share of the Colorado River Bridge near Needles on this route.

A 1.6-mile section of SSR 18 near Camp Waterman has been budgeted for conversion from two-lane highway to four-lane freeway south of the soon-to-be-started Crestline Interchange.

The San Bernardino Freeway (Interstate 10) will be widened from four lanes to eight for 5.4 miles in and east of Ontario with funds provided in the 1964-65 budget.

Farther east, an 11-mile project to convert a four-lane expressway to six-lane Interstate 10 Freeway between Redlands and Beaumont is under construction.

On Interstate 10 in Riverside County, an eight-lane freeway is under construction between Banning and the east city limit of Cabazon, and the new budget provides for extending it another 6.1 miles easterly. A freeway conversion project was completed in January near the Whitewater junction with Twentynine Palms Highway, and a 3.4-mile conversion project is budgeted northwest of Thousand Palms. A 9.7-mile section of four-lane freeway is under construction east of Indio and a 14.1-mile extension easterly is budgeted.

A 4.7-mile freeway on U.S. 60 between Sunnyslope and Riverside was completed in February; a freeway conversion project extending to U.S. 395 in Riverside is budgeted; a four-mile section between U.S. 395 and Sunnymead was completed in January; and construction is underway to extend the freeway 5.4 miles easterly to SSR 79 (new SSR 177), completing freeway and expressway on this route between Ontario in San Bernardino County and Beaumont in Riverside County.

Widening of SSR 111 to four lanes between Palm Springs and Cathedral City and through Palm Desert was completed in October. The widening of the connecting section to four lanes is budgeted. Also budgeted is the five-mile section of this route west of Palm Springs, connecting to Interstate 10, to be widened to four lanes.

A 2.6-mile, four-lane expressway was completed this fall on SHR 187 in Morongo Valley north and south of the San Bernardino-Riverside county line.

Los Angeles Metropolitan Area

The Vincent Thomas Bridge between San Pedro and Terminal Island, the first major, high-level suspension span in Southern California, was opened to traffic on November 15. This $21,000,000 toll structure replaced a ferry service in the Los Angeles Harbor area.

Construction of the Santa Monica Freeway from the Golden State Freeway to the Harbor Freeway in 1962 completed an inner freeway loop around the Los Angeles downtown area. Projects completed in 1963, under construction or budgeted on the San Diego (Interstate 405), Garden Grove (SSR 22) and Interstate 605 freeways will form an outer loop west, south and east of the Los Angeles central district.

Approximately 20 miles of the San Diego Freeway (Interstate 405) were completed in 1963, completing this freeway between the Golden State Freeway north of San Fernando and southeast of the Long Beach Freeway, at a cost of more than $50,000,000. Another 14.7 miles are under construction to extend this freeway southeasterly to Beach Boulevard (SSR 39) in Orange County, and the new budget provides for extending it 2.9 miles farther to Fountain Valley.

Interstate 605 Freeway is under construction for 11.1 miles between the San Bernardino Freeway in El Monte and south of the Santa Ana Freeway in Norwalk, and is budgeted southerly to the San Diego Freeway.

Two miles of the Garden Grove Freeway (SSR 22) are under construction east and west of Beach Boulevard, and a short section west of the Santa Ana Freeway was completed in August. The remaining sections of this freeway, which connects the Santa Ana and San Diego Freeways, have been budgeted.

Approximately 8.5 miles of the Santa Monica Freeway (Interstate 10) are under construction between just west of the Harbor Freeway and the San Diego Freeway. The last section of this route, 3.2 miles between the San Diego Freeway and Pacific Coast

Highway in Santa Monica, was advertised for bids in November.

A 2.4-mile section of the Golden State Freeway south of Osborne Street in Pacoima was completed in February. This freeway was extended northerly past the interchange with the San Diego Freeway to north of San Fernando in November, completing it through the San Fernando Valley.

The 1964-65 budget provides for extending the Hollywood Freeway 1.7 miles northerly to Victory Boulevard in North Hollywood.

The Pomona Freeway is under construction between the East Los Angeles Interchange and Third Street in East Los Angeles. The new budget contains two more projects on this route: One will extend it 1.4 miles easterly to Woods Avenue, interchanging with the Long Beach Freeway, and the other provides for a four-mile section between South San Gabriel and east of Interstate 605.

Several projects recently completed or under construction will convert almost all of U.S. 101 between the Cities of Los Angeles and Ventura from expressway to full freeway standards.

A 4.5-mile freeway loop of U.S. 101 around the business district of the City of Ventura was opened to traffic in the fall of 1962. Work was completed in September to extend it 2.5 miles westerly with an interchange with the Ojai Freeway.

A five-mile section of State Sign Route 126 Freeway between Ventura and Wells Road was opened to traffic in April and construction is underway on an 8.5-mile easterly extension to Santa Paula.

The Antelope Valley Freeway (U.S. 6—new SSR 14) was opened to traffic in October for the 14.4 miles between Solamint Junction and Red Rover Mine Road and construction is underway easterly for 8 miles to Angeles Forest Highway. The 1964-65 budget contains a project which will extend it northerly to Palmdale.

The first project to convert the Ridge Route section of U.S. 99 (Interstate 5) from expressway to full freeway standards between San Fernando and the Kern county line, a three-mile section south of Castaic, is under construction.

Six and a half miles of the Newport Freeway were completed last year, joining the Santa Ana and Riverside Freeways in Orange County, and construction is underway on a two-mile section south of the Santa Ana Freeway.

San Joaquin Valley and Central Mountain Counties

North of Los Angeles county line in Kern County, eight-lane Interstate 5 freeway is under construction for four miles to Fort Tejon, connecting to the completed Grapevine section past Wheeler Ridge where the present route continues north as U.S. 99.

Upon completion of a final 4.8-mile contract last summer, the 17-mile Bakersfield Freeway was fully opened to traffic at an overall cost of more than $13,000,000. Most of the project was opened last year to southbound traffic only.

An 8.5-mile, four-lane expressway section between north of the new Bakersfield project and Cawelo is being converted to six-lane freeway. Conversion of a 3.5-mile expressway section north of McFarland, connecting to completed freeway for 60 miles through Tulare County to one mile south of the Fresno county line, was completed in July.

From this point, south of Kingsburg, a four-lane freeway is under construction northerly for eight miles to Selma, connecting to a recently completed freeway to Malaga. The freeway between Malaga and the Fresno Freeway was completed this fall.

In Madera County, a four-mile expressway-to-freeway conversion is underway north of the Fresno county line.

Farther north on this route, a 4.5-mile freeway bypass of downtown Merced was opened to traffic in October.

In Stanislaus County a two-mile freeway through Ceres and the 5.8-mile Modesto Bypass Freeway are under construction.

North of Stockton, the four-lane expressway for 6.8 miles north of the Calaveras River is being converted to six-lane freeway and the 4.5-mile Lodi Bypass Freeway was opened to traffic in November.

The first project on the 321-mile Westside Freeway (Interstate 5), which will extend from Wheeler

The freeway loop of U.S. 101 around the business district of Ventura completed in 1962 now extends farther west, including an interchange with the Ojai Freeway (upper left).



Construction of a four-lane freeway and expressway on SSR 1 between Morro Bay (below) and 6.2 miles northerly to south of Cayucos was completed last fall. The superseded two-lane highway is at the left of the new facility.





The $13,000,000, 17-mile Bakersfield Freeway on U.S. 99 was completed last summer. Most of its length had been opened to southbound traffic in 1962.

Ridge south of Bakersfield to Woodland, was started this spring in Merced County west of Los Banos. A joint project of the Division of Highways and the U.S. Bureau of Reclamation, it will provide freeway bridges across the San Luis Canal and portions of an interchange with State Sign Route 152.

The new budget provides $5,400,000 for a 8.6-mile project on this route in Merced County, and $8,700,000 for 12.2 miles on the connecting Interstate 580 Freeway south and west of Tracy.

A 12.4-mile, four-lane expressway relocation of State Sign Route 152 around the area to be inundated by the San Luis Reservoir is under construction in the Pacheco Pass area. This joint project of the Division of Highways and the Department of Water Resources will cost more than $13,000,000.

In Kings County, a four-lane freeway on State Sign Route 198 for 6.4 miles easterly from the main gate of the Lemoore Naval Air Station was completed in June. A second project is underway to continue this route as a four-lane expressway for 8.5 miles to Hanford.

On U.S. 466 (new State Sign Route 58) in Kern County, a grading and structures project is under construction for 7.6 miles of four-lane freeway west of Tehachapi. The new budget will complete this project.

In the Sierra Foothills, a 3.1-mile four-lane expressway was completed on State Sign Route 108 west of Twain Harte in October. Two two-lane expressway projects east of Twain Harte grade are financed in the new budget, and a two-lane expressway project on this Sonora Pass route is underway east and west of Long Barn.

Other two-lane expressway projects include:

- 7.3 miles under construction on State Sign Route 41 north of the North Fork Kings River in Kings and Fresno Counties.
- 4.3 miles were completed in February on State Highway Route 135 between north of Corcoran and Kings County and one mile south of the Kings-Tulare county line.
- 5.6 miles under construction on State Sign Route 4 in Calaveras County west of the Alpine county line.
- 3.8 miles were completed in September on State Sign Route 88 (Carson Pass) between Woodfords and Picketts in Alpine County.
- 2 miles are under construction on State Sign Route 120 (Tioga Pass) west of Lee Vining in Mono County.



A 6.4-mile freeway on SSR 198 easterly from the Lemoore Naval Air Station in Kings County was completed in June. Work continues to extend it for another 8.5 miles as an expressway to Hanford.

Sacramento Valley and Northern Counties

A total of 47 miles of Interstate 5 Freeway have been completed or are under construction between Sacramento and the Oregon line, and an additional 40 miles have been budgeted including an initial stage of work on Interstate 5 (Second and Third Street Freeway) in the City of Sacramento. These budgeted projects will cost more than $27,000,000.

A Glenn County section 11 miles long has been budgeted for 1964-65 at $6,600,000 between Artois and the Tehama county line. In Tehama County, a project estimated to cost $13,460,000 is included to provide 22 miles of freeway between Corning and just north of Red Bluff, connecting to a 15.2-mile section nearing completion to north of Cottonwood in Shasta County.

Another budgeted project will continue northerly to the Sacramento River Bridge north of Anderson. Grading and structures are already underway for a future freeway extending north of Redding.

Farther north, the new budget provides for widening the Pit River Bridge. A 5.8-mile section ($9,825,000) between Shotgun Creek and one mile south of Castella was completed in March, connecting with a 7.9-mile section completed earlier to Dunsmuir. The new budget provides funds to convert another 1.1 miles of U.S. 99 Expressway to Interstate 5 Freeway in that city.

A 6.8-mile section north and south of the City of Mt. Shasta will be completed next fall.

On Interstate 80 (former U.S. 40), the principal route between San Francisco and Nevada, a 4.5-mile expressway section east of Vallejo was con-

verted to interstate freeway standards in June. A seven-mile conversion near Dixon will be completed by year's end and another five-mile section near Vacaville next fall.

Three additional Solano County conversion projects totalling 11.5 miles, west and east of Vacaville and northeast of Dixon, have been budgeted, leaving only 8.1 miles of U.S. 40 Expressway to be converted to Interstate 80 Freeway between San Francisco and Sacramento.

Farther east, the three-mile dual-structure Yolo Causeway carrying three lanes of traffic in each direction was completed in October. Traffic had been using part of this facility since the fall of 1962.

The substructure of the W-X Street Bridge across the Sacramento River for Interstate 80 is under construction. The superstructure and two miles of freeway approaches in Yolo and Sacramento Counties have been included in the new budget, and are estimated to cost $18,200,000.

The eight-lane Interstate 80 (29th-30th Street) Freeway in the City of Sacramento connecting the South Sacramento and Elvas Freeways has also been budgeted. Its cost is estimated at $12,700,000.

On Interstate 80 in the Sierra Nevada, a 12-mile project between Emigrant Gap and Hampshire Rocks will be completed next fall. Grading of the 10.6-mile section easterly of Soda Springs was completed in September and a contract for paving this section to complete the Donner Summit relocation will be completed next year.

On U.S. 50, the 1964-65 budget provides $6,200,000 for extending freeway construction ten miles easterly between Folsom Junction in Sacramento County and a mile east of Bass Lake Road in El Dorado County. A two-mile freeway section west of Placerville was completed in September, and two other projects, a two-mile expressway west of Camino and a 5.5-mile freeway section near Pollock Pines, will be completed next year.

Initial freeway construction on U.S. 99E in Chico was completed this fall and work is underway southerly to the Skyway turnoff. The new budget provides funds to complete the freeway through Chico.



Construction is underway on a 6.8-mile section of Interstate 5 north and south of the City of Mount Shasta. The famed snow-covered landmark looms in the background.

A 6.8-mile freeway on U.S. 40 Alternate (new State Sign Route 70) was completed in November, completing the relocation of this route around the Oroville Dam Reservoir.

A 1.9-mile four-lane freeway on SSR 44 easterly from Market Street in Redding and a 4.5-mile two-lane expressway on this route near Palo Cedro are under construction. The new budget provides for extending the latter project another four miles.

The first unit of the four-lane Grass Valley-Nevada City Freeway, 3.3 miles, is financed in the new budget.

In Sutter County, a 3.6-mile four-lane expressway on SSR 20 west of Yuba City will be completed next summer.

Two-lane expressway projects include: 4.4 miles on U.S. 299 east of Douglas City in Trinity County completed this year; 3.3 miles on U.S. 299 northeast of Adin in Modoc County under construction; 5.3 miles on U.S. 395 between one mile south of the Lassen-Modoc county line and four miles north of Likely completed in July; 1.3 miles on SSR 89 at the southern end of Lake Almanor in Plumas County, completed this fall; and 2.2 miles on SSR 20 west of Meridian in Colusa County, completed this fall.

Central Coastal Counties

Seven miles of two-lane expressway on State Sign Route 154 north of San Marcos Pass in Santa Barbara County will be completed in early 1964 to realign the existing highway and eliminate tortuous curves and steep grades, in conjunction with a recently completed steel arch bridge across Cold Springs Canyon.

A 2.6-mile freeway section on U.S. 101 in the City of Santa Barbara is nearing completion, and a freeway bypass of Buellton on this route is now under construction.

An 8.5-mile two-lane expressway on State Sign Route 154 between Surf and Lompoc and a freeway between the University of California at Santa Barbara campus and U.S. 101 at Goleta were completed this summer.

A 1.5-mile section of U.S. 101 Expressway was converted to freeway standards south of San Luis Obispo in May, and work continues to convert the expressway southerly to Pismo Beach.

A four-mile freeway construction project on U.S. 101 is just starting between north of San Miguel and north of Gate 1, Camp Roberts, in Monterey County. The new budget will extend the freeway to connect with construction in progress between Bradley and San Ardo which will be completed next summer.

Farther north on U.S. 101, a six-mile freeway bypass of Gonzales was completed in July and a 4.5-mile freeway between North Main Street in



This section of SSR 108 west of Twain Harte in Tuolumne County completed in October typifies four-lane expressway construction in many scenic areas. The former highway, at left, connects with the expressway at left foreground.

Salinas and north of Espinosa Road has been budgeted.

On State Sign Route 1, between Morro Bay and south of Cayucos, a 6.2-mile four-lane freeway and expressway was completed this fall. Completion of a 3.6-mile two-lane expressway relocation of this route to bypass Cambria to the west is expected in early 1964.

Construction of a two- and four-lane expressway was completed in May for three miles of State Sign Route 156 north of Hollister in San Benito County.

San Francisco Bay Region

The most costly project completed in 1963 in the Bay region and the one offering the most immediate and dramatic traffic improvement was the opening of the new 5,923-foot Webster Street Tube at a cost of approximately $19,000,000, and the renovation of the paralleling Posey Tube between Alameda and Oakland. The renovation project was completed in November and now each tube carries two lanes of one-directional traffic.

Three projects are under construction to extend the eight-lane Interstate 580 (MacArthur) Freeway, which was completed between the San Francisco-Oakland Bay Bridge distribution structure and Park Boulevard in Oakland last year, another 11 miles to Sybil Avenue in San Leandro at a cost of $24,600,000.

Work is underway to construct a new 3,371-foot two-lane bore on SSR 24 paralleling the existing Caldecott Tunnel through the Berkeley Hills at a cost of almost $11,000,000. When it is completed next fall, the existing tunnel will be renovated. A two-mile, eight-lane freeway connecting the tunnel's east end to Orinda Highway should be completed next year.

Funds have been budgeted to construct a future eight-lane freeway west of the tunnel on SSR 24.

Widening of 5.6 miles of the Nimitz Freeway from six to eight lanes in Oakland was completed in September. A 1.7 mile length of four-lane divided highway on Jackson Street (new SSR 92) in Hayward was opened in April. The new budget provides funds to convert this latter route from two-lane highway to four-lane freeway between the east end of the San Mateo-Hayward Bridge and the expressway at Hesperian Boulevard.

The Interstate 680 Freeway was opened to traffic by year's end between SSR 9 near Mission San Jose and SSR 84 east of Sunol, and work should start soon to construct this freeway between south of Dublin and one mile north of the Alameda-Contra Costa county line. The new budget will finance construction northerly to one mile south of Danville.

Work is underway to construct the Interstate 680 Freeway between south of Danville and Walnut Creek. The 1.7-mile gap on this route between Pleasant Hill and Concord was recently opened to traffic, completing the freeway from Walnut Creek to the Benicia-Martinez Bridge.

The 1964-65 budget provides funds for five miles of SSR 4 Freeway in Contra Costa County east of Cummings Skyway.

In San Francisco, the Southern Freeway has just been completed between the interchange with the James Lick Memorial Freeway and Alemany Boulevard near Mission Street. Three projects are underway to extend this freeway westerly to near the south city limits and for one-half mile easterly as a viaduct. Funds have been budgeted to extend the viaduct facility easterly to Army Street.

Work will start soon on a connection between the Southern Freeway construction in progress and the Interstate 280 (Junipero Serra) Freeway in Daly City and on SSR 1 between St. Francis Boulevard in Daly City and Interstate 280.

Bids were received in December for the construction of the ramps between Interstate 480 (Embarcadero) Freeway and Clay and Washington Streets in the Golden Gate Redevelopment Area.

In San Mateo County, the first project on the SHR 105 (new SSR 92) Freeway west of the Bayshore Freeway was completed in October.

Construction started this spring on 3.3 miles of four-lane SSR 1 Freeway in Pacifica.

The new budget allocates $15,800,000 to extend the Interstate 280 Freeway southerly to west of South San Francisco and to construct two freeway bridges across San Mateo Creek near Hillsborough.

Bids were received in November for construction of a 1.3-mile SHR 214 (new SHR 114) expressway between the Bayshore Freeway and Cypress Avenue in Redwood City as a joint project with the city.

In Santa Clara County, construction emphasis is on the Interstate 280 and SHR 114 (new SR 85) freeways.

On the former route, construction is underway between San Jose and Cupertino, and the new budget provides funds for 7.2 miles of this route between Mountain View-Stevens Creek Road in Los Altos and Los Altos Hills. Work has started on the SHR 114 (new SR 85) Freeway between Cupertino and the Bayshore Freeway in Mountain View.

In Santa Cruz County, the second of several projects to convert the SSR 1 Expressway between Santa Cruz and Rob Roy Junction to full freeway standards was completed in November, and bids were opened in

November for grading and structures on the freeway bypass route west of Watsonville.

Two major projects are underway in Marin County in and south of Novato to convert four miles of U.S. 101 from expressway to freeway.

Farther north, the new budget will convert a U.S. 101 section in Santa Rosa from expressway to freeway standards with a connection at Steele Lane, and two projects to convert four miles of U.S. 101 to freeway south of Cloverdale will be completed next year.

The first unit of the SSR 12 Freeway, a 4.3-mile section between east of Sebastopol and Santa Rosa, will be completed next spring.

The substructure of the high-level Napa River Bridge on SSR 48 (new SSR 37) west of Vallejo was completed in April. The new budget provides funds for the superstructure.

Northern Coastal Counties

In Mendocino County, 5.2 miles of four-lane U.S. 101 Freeway north of Ukiah were opened to traffic in November and construction is underway south of the city. A contract was awarded in September for structures for the section through the Ukiah area on this route.

In Humboldt County, a 5.7-mile section of the Redwood Parks Freeway was completed on U.S. 101 in October, extending a previously built 12-mile section southerly to Maple Hills Road Bridge. Another 5.9-mile section is underway to south of Phillipsville. The 1964-65 budget contains funds for an extension southerly to Dean Creek.

A 3.7-mile section of U.S. 101 near Fields Landing was completed in April and construction is underway for 3.5 miles northerly to the Elk River, which will complete freeway construction from south of Fortuna to Eureka.

Continuing north, eight miles of freeway are under construction between Mad and Little Rivers, and 1.5 miles of U.S. 101 Expressway in and near Arcata will be brought to full freeway standards by a project included in the 1964-65 budget.

A $4,300,000 contract for clearing and grading for five miles of U.S. 101 freeway between 0.9 mile south of the Del Norte county line and 1.1 miles south of Klamath was awarded in March. The new budget will finance construction of a 2,000-foot bridge across the Klamath River.



Construction of 22.6 miles of Interstate 80 in the Sierra Nevada will be completed next fall, providing continuous freeway and expressway on this route between San Francisco and the Nevada border. In photo above, the new Interstate freeway crosses over SSR 20. U.S. 40, which will be superseded, carries traffic in the background.

The Randolph Collier Tunnel under Hazelview Summit on U.S. 199 and 4.2 miles of two-lane expressway approaches were completed in July at a cost of more than $7,500,000, eliminating five steep switchbacks and 128 turns and shortening this route to Oregon by 2.8 miles.

Other significant northern coastal county projects include:

A 2.9-mile, two-lane expressway under construction on SSR 1 near the City of Mendocino. A project in the 1964-65 budget will extend it 4.4 miles northerly to Mitchell Creek.

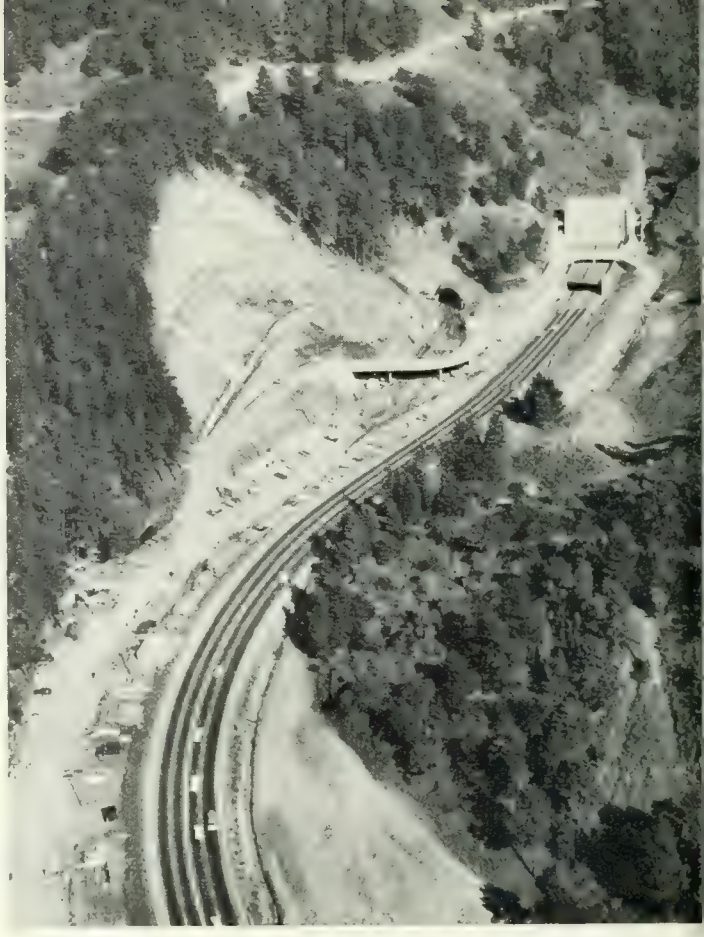
A 3.3-mile, two-lane expressway on SHR 56 under construction between Ferndale and Fernbridge.

A $5,600,000 project in the 1964-65 budget will extend the U.S. 299 Expressway as a freeway between west of Mad River and Blue Lake.

The Eagle Point Viaduct carries the Redwood Parks Freeway (U.S. 101) traffic on part of a 5.7-mile freeway section completed in October south of Myers Flat.

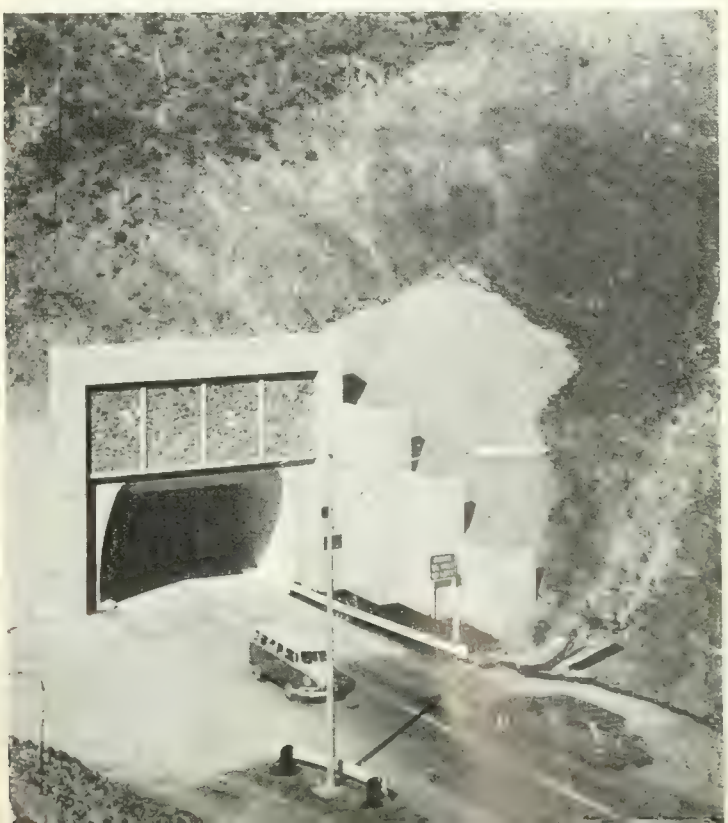




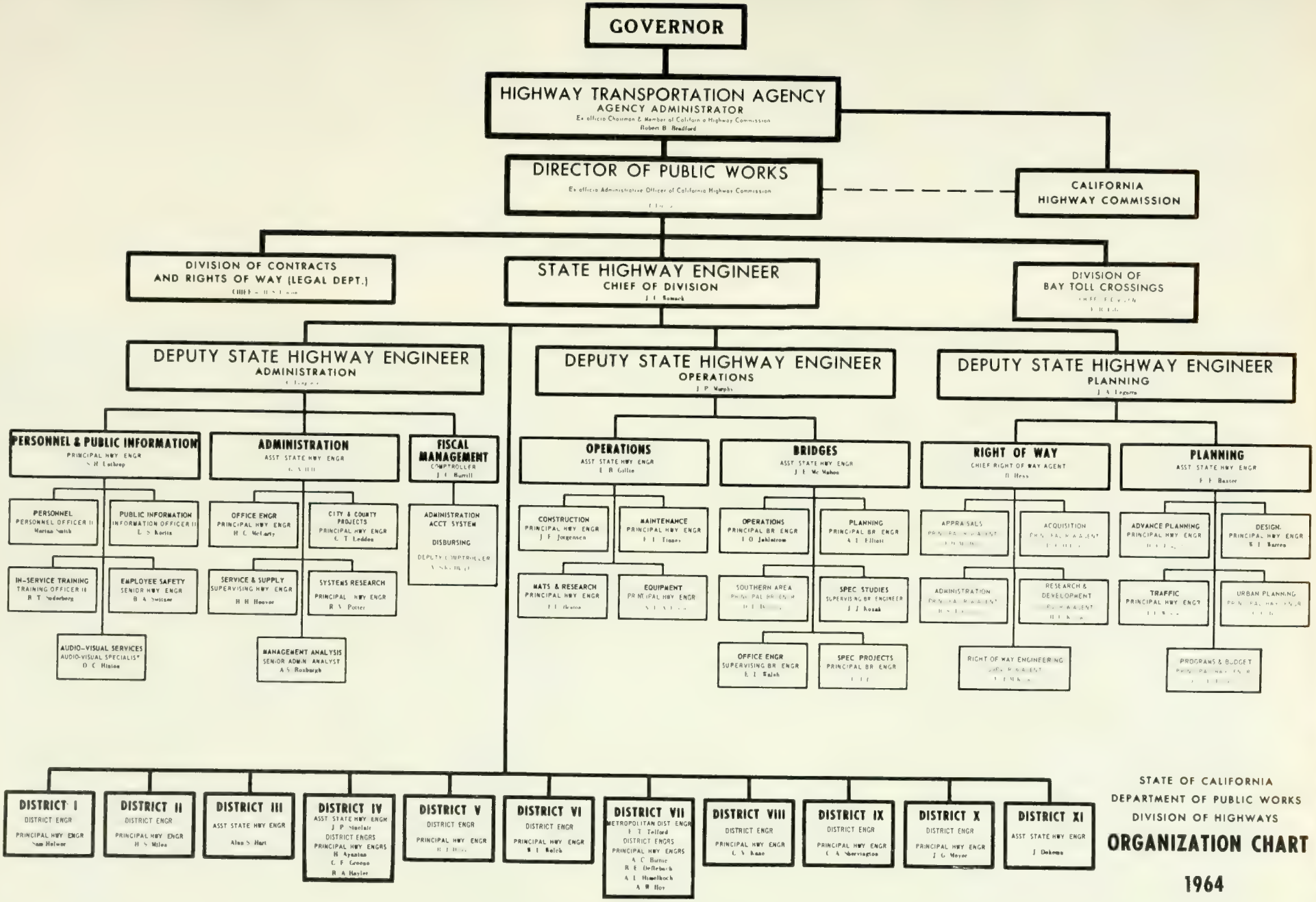


Traffic Moves in New Tubes and Tunnels Under Water and Through Mountains

When the 5,923-foot Webster Street Tube (upper left) under the estuary between Alameda and Oakland was completed in February at a cost of over $19,000,000, it handled two-way traffic until the paralleling Posey Tube could be renovated. This was completed in November. Now each tube carries two lanes of one-directional traffic. A new two-lane bore, paralleling the existing four-lane Caldecott Tunnel (upper right) through the Berkeley Hills on SSR 24, will be completed next year as will an eight-lane freeway connecting the tunnel's east end to Orinda Highway. The new bore will cost nearly $11,000,000. The Randolph Collier Tunnel through Oregon Mountain on U.S. 199 (south portal shown below left) and 4.2 miles of two-lane expressway approaches were completed in July at a cost of more than $7,500,000. Their completion eliminated five steep switchbacks and 128 turns and shortened this route to Oregon by 2.8 miles. The old tortuous, climbing highway over Hazelview Summit is shown at lower right.







STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

ORGANIZATION CHART

1964

Operations

The construction, maintenance, equipment and materials and research departments are administered under the direction of the Assistant State Highway Engineer—Operations

CONSTRUCTION

In the 1962-63 fiscal year 504 major contracts administered by the districts were completed at a cost of $317,550,697.

Each construction contract is under the direct administration of a resident engineer. The work on several contracts in an area is supervised by a construction engineer. All of the construction work in any one highway district is under the general supervision and administration of an assistant district engineer who reports directly to the district engineer. Headquarters Construction acts as a staff department for the State Highway Engineer for purposes of co-ordination uniformity of contract administration.

The engineers and technicians perform the staking, inspection and testing necessary to lay out the project and to insure that the terms of the contract are met. When revisions of plans and specifications are necessary the engineer must investigate and initiate the covering changes.

Grading operations on the Interstate 80 relocation at Emigrant Gap in the Sierra Nevada.



The work itself is performed by the contractor's organization and forces. It is the contractors job to plan his work, determine what methods and equipment he will use, procure and produce the necessary materials, and to accomplish the planned project according to the lines and grades set by the engineer, in compliance with the specifications governing the work.

Special Projects

The paving engineer of Headquarters Construction Department with the co-operation of the Portland Cement Association and the division training officer started a program of presenting the latest techniques in portland cement concrete paving. This program was started in the spring of 1963 and will be continued. All possible field personnel who are involved in the inspection of concrete paving attended a program consisting of slides and lectures with discussion periods following.

Experimental Sections

On two contracts, experimental sections of concrete paving using a special shrinkage-compensated cement were placed. The purpose of this experiment was to explore possibilities of obtaining satisfactory performance from pavements without joints.

The department developed and issued a uniform system of indexing and filing contract records and documents for the project field offices. This system furnishes supporting data for the new contract records procedure and effects considerable savings in the field offices.

Tolerance Study

The study of tolerances in the various elements of the structural section of the roadway is a continuing project and the results of the construction on each project are tabulated by the electronic data processing unit of the division.

Construction Practice

The ingenuity of the highway construction industry was again demonstrated during the past fiscal year by the development of attachments to the

slip-form paving train on portland cement concrete paving which automatically inserts the polyethylene plastic strips in the longitudinal and transverse joints in the fresh concrete.

Central-mixed concrete for paving was used more extensively during the past fiscal year.

Honor Camp Projects

The Division of Highways and the Department of Corrections continued the joint operation of Camp No. 41 near Happy Camp on the Klamath River in Siskiyou County, and Camp No. 42 near Lord Ellis Summit in Humboldt County.

Klamath River Highway

Camp 41 continued construction on the portion of the Klamath River Highway between 1.7 miles north of Dillon Creek and Clear Creek, a distance of about 11 miles.

Construction was completed on one portion between Wright Ranch and 0.2 mile east of Happy Camp. Construction was started on a 1.7-mile section south of Dillon Creek.

Most of the work performed by Camp 42 during the fiscal year was concentrated in Unit 4 which is located in the vicinity of Redwood Creek Bridge.



A northward view of the new Golden State-San Diego Freeways junction (Interstate 5 and 605) north of Los Angeles. The freeway may be seen starting up the Ridge Route through the mountains in the distance. The San Fernando Reservoir is at the left.

MAINTENANCE

Approximately 3,700 maintenance men are employed by the Division of Highways, working out of 267 maintenance stations. It cost a total of $45,670,000 to maintain 14,650 miles of highways in the state system for the 1962-63 fiscal year.

Pavement Repair and Bridge Maintenance

During the summer months, maintenance forces undertook a moderate program of surface restoration, including the reprocessing of asphalt, application of leveling blankets, surface planing, seal coat application and base restoration. Contracts (financed from maintenance funds) were let for screening seal coats considered as replacements. Approximately 222 miles of road surface were covered in this program at an estimated cost of approximately $479,000.

The Maintenance Department again reviewed road surface needs and prepared the annual resurfacing and seal coat program, called the "thin blanket" program, which covered 631 miles of resurfacing and 44 miles of delayed seal coat, at an estimated cost of about $5,000,000 (financed out of construction funds and performed by contract). During the 1962-63 fiscal year, a total of $1,490,000 in maintenance funds was spent for surface and base restoration work. This covered 973 miles of traveled way and 1,092 miles of shoulder work. During the year, limited use (about $47,000) was made of mudjacking pavement restoration.

The Bridge Department prepares and makes recommendations for the painting and repair of bridges on the state highway system. The direct field cost of this work undertaken during the past fiscal year which was considered a maintenance obligation was approximately $625,000, including $208,900 under contracts and $416,100 for work performed by city and state forces.

Ferry Operations, Maintenance in Cities and Roadside Cleanups

The Benicia-Martinez Ferry was in operation until September 15, when the new toll bridge was opened to traffic. Expenditure in maintaining the ferry operation during this period approximated $58,800.

The construction of the deep water channel from Rio Vista to Sacramento requires that the cable-operated ferry known as the Ryer Island Ferry, which crosses Cache Slough about 2.4 miles upstream from Rio Vista, be rebuilt and converted to a free-running ship. Conversion of this ferry has now been completed.



The skymaster being used to wash signs on the U.S. 99 freeway in Sacramento.

Under state law, the State can authorize contracts with cities or counties covering maintenance of state highways and certain features of maintenance work are delegated to cities. Maintenance funds in the amount of $1,651,000 were expended in maintaining state highways within 335 cities.

Removing litter continues to increase despite publicity campaigns by public service organizations and others. The distribution of litter bags at service stations and laws prohibiting the disposal of rubbish on highways have aided in controlling the roadside garbage problem. In spite of these efforts, roadside cleanup continues to be a costly maintenance item. In 1962-63 it cost $2,247,000 for roadside litter removal and street sweeping.

Roadside Vegetation, Tree Care and Landscaping

Several programs have been instituted during the past fiscal year relative to roadside and landscape maintenance. Growth-inhibiting chemicals have been tested in an attempt to reduce the cost of mowing while retaining attractive roadsides. Spraying was done at the manufacturers rates and with assistance from their personnel.

Several 24-foot hydraulically operated spray booms have been obtained. Mounted on 2,000-gallon spray rigs, they allow broader and faster roadside spraying. Other spray rigs have been equipped with fingertip solenoid control mechanisms to enable greater flexibility of small spray bars and spray nozzles. Roadsides which will be treated for fire control will be sterilized. Roadsides which will be treated to reduce mowing will be sprayed with contact herbicides after seed germination and before the resultant vegetation becomes large enough to leave a serious fire hazard. Summer spraying will be required where deep-rooted perennial plants may cause unsightly roadsides.

As in the past, chemical herbicides are continually being evaluated and used in greater numbers to control weeds in landscaped plantings, thus greatly reducing the amount of labor required. A new heavy duty mechanical edger was produced by Headquarters Shop for edging hundreds of miles of ice plant, vinca, ivy or other ground covers and a companion machine which will pick up, grind and redistribute the cuttings from the former machine back into the plantings from which they were taken is now being developed. Landscape maintenance and roadside vegetation control cost $6,929,000 in the past fiscal year.

Lighting, Signals, Electrical Devices

Maintenance of highway lighting, illuminated signs and electrical devices continues to expand at a rapid rate. The complexity of traffic signal equipment continues to increase. The outlook is for more rapid and revolutionary change in the technical complexity of this type of equipment.

During the past year, there has been considerable experience with the inductive loop detector. Loop detectors from three different manufacturers have been installed in the field. Each manufacturer has one, two or more models with different circuitry and different construction. During the year, some of the component parts have been changed to improve the detector. In the field the location of the loop in the left turn pocket is frequently changed to detect and handle traffic better.

In the future much of the division's control equipment will be solid state which will revolutionize controllers and detectors from those of today.

The increases during the fiscal year in highway lighting, illuminated signs, traffic signals and electrical devices serviced by the highway traffic signal and electrical crews are as follows:

The increase in the number of lamps used in highway lighting was 5,651 for a new total of 27,695. Of these, 3,394 were mercury vapor lamps, 1,983 were incandescent lamps and 274 were fluorescent lamps. The mercury vapor lamps vary in lumen output from 35,000 lumens to 6,800 lumens. The incandescent lamps vary from 15,000 lumens to 2,500 lumens and from 1,000 watts to 300 watts. The fluorescent lamps are 96 inches and 72 inches long.

The number of fluorescent tubes and incandescent lamps used in lighting tunnels on state routes increased by 1,243 for a new total of 7,066 lamps. The fluorescent tubes are 96 inches and 72 inches long.

The number of photocells, cadmium sulphide cells, plain and astronomical time switches and series multiple relays used in switching the electrical circuits for highway lighting and tunnel lighting increased by 145 for a new total, 1,463.

The increase in traffic-actuated controllers and railroad and fire station pre-empted controllers was 196 for a new total of 1,675 controllers.

Fixed-time controllers increased by 24 for a new total of 602.

The increase in electrically or electronically operated timers at intersections was 190 for a new total of 1,471.

These timers control the movements of pedestrian traffic in the intersection.

The number of fluorescent tubes, neon tubes and incandescent lamps used in illuminated signs increased by 6,808 for a new total of 19,495.

The number of photocells, cadmium sulphide cells, plain and astronomical time switches used in switching the electrical circuits for these illuminated signs has increased by 12 for a new total of 208.

The number of flasher mechanisms used to operate one-way, two-way, three-way and four-way flasher units on state highways increased by 67 for a new total of 485.

The number of knockdowns of lighting, signal, and illuminated sign facilities increased by 222 per year for a new total of 1,085 per year. A knockdown is where a lighting pole, traffic signal pole, signal cabinet, illuminated sign pole or any other lighting, signal or sign facility is actually knocked down. It also includes situations where the lighting, signal or sign facility is damaged by a car or truck beyond what constitutes regular maintenance.

During the past fiscal year $3,205,000 was expended in maintaining lighting, signals and other traffic devices.

Highway Signs and Pavement Markings

New machines have been constructed by the Equipment Department for use in placing thermoplastic traffic striping. The use of the thermoplastic material on pavement markings has proven quite satisfactory.

During this past winter an experiment was performed on Interstate 80 where three two-mile sections were selected to determine its value and economy of use under actual traffic and climatic conditions. The first section was located at the 1,500-foot elevation, and the second at the 6,000-foot elevation, both on the western slope of the Sierra, while a third was located east of Truckee at approximately the 5,500-foot elevation. These experimental sections consisted of longitudinal grooves in the pavement. The grooves in the four-inch stripe were cut to a depth of one-eighth of an inch with a spacing of one-sixteenth of an inch between grooves. This type of grooving provided a firm base for the hot thermoplastic material. Several types of thermoplastic material were applied with variable results. In some areas the material was practically lost and in others there was a 90 percent retention. It is felt that these methods were much better and more economical than our standard traffic stripe painting, which under sanding operations during the winter months has been completely lost after each storm.

There will be more experimentation this coming winter and it is anticipated that results will be more satisfactory as thermoplastic materials are improved.

In the 1962-63 fiscal year, $2,547,000 of maintenance funds were expended in replacing traffic stripes, pavement markings, repairing and replacing signs.

Communications

The division's statewide radio system at the end of the fiscal year consisted of 1,390 mobile radio units, 200 radio stations, 49 microwave stations and 125 hand-carry units.

Improvements were made in the districts to provide expanded and more reliable mobile radio coverage. The installation of special equipment at Sacramento now provides direct radio contact to all districts. In addition to the use of radio communications in maintenance work, radio is now used in major construction projects, bridge maintenance, geodometer surveys, and materials and research projects.

The division continued operation of its leased, private-line teletypewriter systems. This automatic system, consisting of 20 stations, is connected to all the district offices, Sacramento, and various key departments. The speed of the system was increased from 60 to 75 words per minute. Approximately 3,300 messages were handled per month.

As a continuing winter service the division furnished road and weather information, gathered and disseminated by the radio and teletype system, to news media, radio and television stations, automobile clubs, governmental agencies, trucking concerns and other interested groups. The service was offered from January to May.

Outdoor Advertising Section

As in previous years, the regulation of outdoor advertising displays adja-

A maintenance crew repairs a section of chain link fence on the San Diego Freeway (Interstate 605) in Los Angeles.



cent to public highways unincorporated areas has been administered and financed solely through revenue derived from license and permit fees.

Operations and enforcement activities were maintained at the level compatible with the fee schedule effected in 1959 when the Outdoor Advertising Act was amended to provide, through increased permit and license fees, the revenue required to meet rising costs of operation.

For comparison, records showing the last three calendar and fiscal years are as follows:

Number of advertising operators licensed for each fiscal year:

1960-61	838
1961-62	880
1962-63	884

Number of permits issued during the calendar year:

	Signs	*Structures*
1960	1,115	35,126
1961	972	34,357
1962	1,826	33,258

Gross receipts—license and permit fees and penalties for each fiscal year:

1960-61	$127,104.25
1961-62	124,693.32
1962-63	118,047.78

Permits

During the past fiscal year the number of transportation permits issued for extralegal hauling operations increased some 34 percent over the preceding period. This resulted from the lapse of state authority to issue annual permits for overwidth trailer coaches. This authority was restored by emergency legislation early in the 1963 session and should reduce the workload considerably. The Los Angeles and San Francisco Districts, in that order, continued to handle the largest volume of permits. Military certifications handled during the fiscal year decreased slightly, averaging about 38 cases per month.

The encroachment permit function remained fairly constant with the Los Angeles and San Francisco Districts processing some 37 percent and 14 percent respectively of the statewide total.

Following is a comparison of the number of permits issued for both functions during the past three fiscal years:

	1960-61	*1961-62*	*1962-63*
Encroachment permits	13,151	12,778	12,453
Transportation permits	70,306	75,603	101,542
	83,457	88,381	113,995

Truck Scales

Plans have been developed by the Office of Architecture and Construction for six new truck scale installations as a part of new freeway construction located as follows:

Little River, north of Arcata on U.S. 101.

Northbound Cottonwood Scale on U.S. 99, approximately one mile south of Cottonwood.

Northbound Castaic Scale expanded to include brake inspection facility south of Castaic Junction.

Banning Scales (replacing the existing ones at White Water) expanded to include a brake inspection facility for westbound movement only.

Dominguez Scales on the San Diego Freeway in Los Angeles.

Montalvo Scale replacing existing facility near Montalvo on U.S. 101.

The Little River, Banning, Cottonwood and Castaic scale installations are under construction and will be completed during the coming fiscal year. The Dominguez installation in Los Angeles was completed in 1962-63 fiscal year. New loadometer pits have been made at several locations through the State where problems in connection with overloads justify their installation.



In February 1963 high water washed out this section of State Route 102 near Conn Dam in Napa County.

Maintenance Stations

Contracts were let for new station facilities at nine locations throughout the State. New superintendents' offices, employee cottages, equipment garages and other facilities were built at an approximate cost of $1,108,000. Preliminary work, site selection or land acquisition has been undertaken for 14 new maintenance stations.

Road Closures

Only minor road closures occurred during the first part of the summer from forest fires and minor flash floods in desert areas.

An unprecedented storm hit Northern California in mid-October, depositing up to seven inches of rainfall in Sacramento and heavier amounts in other areas and causing the following road closures:

Caldecott Tunnel (on Sign Route 24)	Oct. 13-16
U.S. 40 Alternate (Feather River Highway)	Oct. 12-16
Sign Route 32 (Deer Creek Highway)	Oct. 13-14
U.S. 395 (at Litchfield near Susanville)	Oct. 12-16
Sign Route 89 (at Blairsden)	Oct. 12-13
Sign Route 44 (north of Viola)	Oct. 12-13
U.S. 299 (Montgomery Creek—Burney area)	Oct. 12-13
Sign Route 36 (Morgan Summit—Susanville area)	Oct. 12-13

Sign Route 16 (Woodland —Sacramento area)	Oct. 12-15
Legislative Route 45 (Willows—Biggs area)	Oct. 12-15
Sonora Pass (State Route 108)	Oct. 12-23
Tioga Pass (State Route 120)	Oct. 13-15

U.S. 50, approximately one-half mile east of Echo Summit, was closed during the last week in November to permit removal of an overhanging rock and reopened to traffic on November 30.

The bridge across the Sacramento River at Rio Vista on SR 12 was closed while the lift span was up on the night of December 18 when dredging operations severed the submarine power cable and was not reopened until December 21.

A heavy ground fog prevailed over most of the Sacramento Valley and portions of the San Joaquin Valley during the first part of January causing numerous delays.

A series of storms occurred during the last week in January and the first part of February, 1963, and caused widespread damage in Northern California. Heavy rainfall occurred up to the 8,000-foot elevation causing exceptionally high water in the Feather, Yuba and American drainage river areas. This storm caused flooding resulting in temporary road closures at numerous locations. Major road closures were as follows:

U.S. 40 (near Cisco)	Jan.31-Feb.
U.S. 40 Alternate Feather River Highway)	Jan. 31-Feb. 3
U.S. 50 (Pacific House—Kyburz area)	Jan. 31-Feb. 1
Spanish Creek Bridge (west of Quincy)	Jan. 31-Feb. 3
State Route 36 (Mineral —Doyle area)	Jan. 31-Feb. 2
State Route 89 (Emerald Bay area)	Jan. 30-Feb. 5
U.S. 395 (north of Bridgeport)	Jan. 31-Feb. 4
State Route 16 (Woodland-Sacramento area)	Feb. 1-Feb. 8
State Route 120 (Big Oak Flat Road)	Jan. 29-Feb. 27
State Route 49 (west of Downieville)	Jan. 31-Feb. 13

SR 128 at the Montebello Damsite was closed due to slides April 14 to April 16.

High water in the Yolo Bypass on SR 16 between Woodland and Sacramento was closed April 8 to April 25.

An earthquake in the Imperial Valley resulted in the May 29 closing of the westbound lanes on the New River Bridge near Seeley and reopening on June 28.

Major Slides and Storm Damage

After the intense October 12 storm, precipitation was meager until late January when a severe storm encompassed Northern California.

The Governor declared a state of emergency due to the extensive damage resulting from the storm.

The Caldecott Tunnel between Berkeley and Walnut Creek on SR 24 was closed due to mudslides and power failures.

High tides along the coast in the Los Angeles area near Redondo Beach caused extensive damage. Numerous slides and high water occurred, closing routes throughout California.

Two slipouts of major importance occurred on U.S. 40 on January 31 between Baxter and the Whitmore Maintenance Station and a washout on this route in the vicinity of Cisco resulted in major damage at this location.

Heavy rockslides occurred on U.S. 50 between Pacific House and Riverton. There was minor damage to embankments due to high water between Susanville and Doyle on SR 36 and loss of embankment near Litchfield on U.S. 395.

Approximately two miles of roadbed were destroyed on SR 49 due to high waters in the Downieville area.

The total damage to highway facilities as a result of the January-February storm was approximately $4,051,000.

Snow Removal

The unusual winter reduced the snow removal and pavement sanding costs to approximately $2,647,000 or 5.8 percent of the maintenance budget.

The October 12 storm caused some temporary road closures due to snowfall at the higher elevations. However, snow in appreciable quantities requiring snow removal from highways in the mountains was not started until the middle of March. The snowpack on Donner Summit at the end of March amounted to 53 inches as compared to an 85-inch snowpack for the preceding season. Additional storms in April increased the snowpack in the Sierra and boosted the rainfall in Sacramento to some 25 percent above normal. The maximum snowpack at Donner Summit was 90 inches on April 20 with some 45 inches remaining on the ground on May 1. Heavy snow and blizzard conditions closed U.S. 40 over Donner Summit for seven hours on April 15 and eight hours on April 19.

Pavement sanding operations in the mountainous areas of the State were aided by the addition of new sand houses at strategic points, either as a part of a major highway project or as maintenance station facilities.

Closing-Opening Dates

The closing and opening dates of mountain roads for which snow is not regularly removed during the winter are as follows:

Route	*Name*	*Closing Date*	*Opening Date*
SR 89	Lassen Park	October 10	May 30
SR 89	Luther Pass	February 1	February 5
SR 88	Carson Pass	December 2	June 4
SR 4	Ebbetts Pass	December 3	May 31
SR 108	Sonora Pass	November 27	June 7
SR 120	Tioga Pass	November 27	May 30
SR 89	Monitor Pass	January 30	May 3
SR 120	Big Oak Flat	January 29 March 14	February 27 May 1

MATERIALS AND RESEARCH DEPARTMENT

Control of the materials purchased and used on state highways is the responsibility of the Materials and Research Department in Sacramento and by 11 district laboratories.

In general, Headquarters Laboratory tests and inspects all products manufactured at locations other than jobsite, carries on research projects, makes foundation studies and special investigations as requested by other departments. The major portion of the work of the district laboratories is the testing required for contract control of materials produced by the contractors, preliminary exploration of materials sites and preliminary investigations of foundation conditions along proposed highway alignments. Headquarters Laboratory performs more than 150 different types of tests while the district units are equipped to do approximately 33.

The various phases of inspection, testing, research, and exploration require approximately 300 full-time persons in the Materials and Research Department. The district employs 340.

The work of the department falls into four general classifications: standard procedures or routine testing; preliminary investigations; research; and training.

Standard Procedures or "Routine" Testing

This accounts for approximately 50 percent of the workload. It covers the task of setting up and controlling the materials for highway contracts—including inspection at manufacturing plants; routine testing in the laboratory; and the final sampling and testing required by the U.S. Bureau of Public Roads.

During the year, 5,146 aggregate samples were received and processed for various purposes, and 260 settlement devices were installed at bridge approaches to expedite the completion of many projects. The final record test program involved 1,862 individual samplings from 1,470 lane-miles of new construction. Aggregate base, subbase, and pavement soil samples totaled 4,366. There were also 6,866 tests on asphalt paving mixtures, and 6,300 portland cement concrete samples taken.

Approximately 11,000 samples of asphalts and road oils were tested in the department's three asphalt laboratories, located at Sacramento, Los Angeles, and Bakersfield.

More than 2,300 tests of various construction materials were performed on steel products, concrete pipe, ceramic tile, waterstop, plastic glare shield, etc.

The following amounts of fabricated and manufactured products were inspected:

Electrical conduit	5,620 l.f.
Clay pipe	120,849 l.f.
Concrete pipe	491,118 l.f.
Steel pipe	625,870 l.f.
Cast iron pipe	1,090 l.f.
Miscellaneous iron and steel	6,676,591 lb.
Guard rail	912,851 l.f.
Treated and untreated timber	769,482 b.m.
Expansion joint filler	456,007 sq.ft.
Rubber waterstop	56,742 l.f.
Corrugated metal pipe	777,708 l.f.
Structural steel	71,643,964 lb.
Reinforcing steel	170,460,062 lb.
Precast, prestressed girders	221 each

The cement laboratory performed about 1,600 tests on 7,500 samples of portland cement concrete, sand, and other materials. More than 600 samples of portland cement, representing approximately 2.5 million barrels of Type II cement, were tested for compliance.



Control readings on stress and strain meter gauges are being recorded on this reinforced steel culvert for design engineers. Readings were taken at regular intervals as the culvert was covered over with a 200-foot-high fill.

The chemistry laboratory made 6,660 chemical analyses on such varied materials as paint, cement, soil, culvert material, thermoplastic, and other materials.

X-ray diffraction equipment was put into operation during the year. In addition to providing research information it was used to determine specification compliance for paints. Approximately 30,000 gallons of paint were rejected because of formulation deficiencies during the first six months of operation of the new instrument.

The 11 district laboratories reported over 130,000 tests for various control purposes.

Preliminary Investigations

The Materials and Research Department is called upon to make studies during the planning and design stages of many projects. Approximately 1,100 materials reports, typical sections, materials handouts, and preliminary reports were referred to the department for review by staff engineers to determine the adequacy of materials data and specifications.

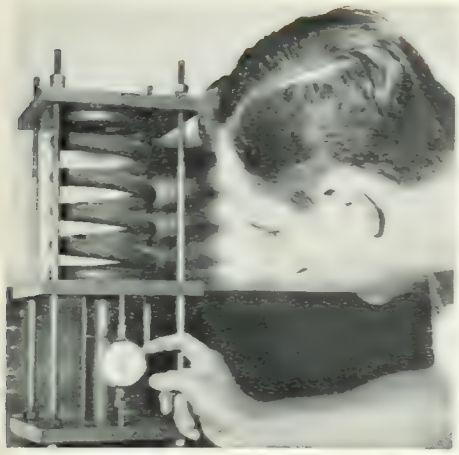
The drill rigs of the department drilled 132 holes, with 2,100 feet for soil sampling, 3,300 feet of cores in rock, and 4,100 feet of rotary drilling in rocky formations during the year.

Foundation explorations included not only highway projects but also several jobs involving state buildings.

The number of geological field studies and geophysical surveys made by the geology unit this year increased considerably. These included cut slope investigations, landslide studies, rippability estimates, materials site investigations, alternate route comparisons, and preparing material to be used in court cases.

The soils mechanics unit prepared 38 comprehensive reports on foundation studies for seven districts, the Bridge Department, and Sacramento County. These studies required the processing of 1,470 soil samples from 274 borings and the performing of 350 consolidation, 1,112 unconfined compression, and 278 triaxial compression tests.

More than 15,000 lineal feet of drains were installed during the year and 47,000 feet of existing drains were



A wide variety of special tests are performed to develop specifications and evaluate materials. Here, a testing engineer makes micromeasurements to determine creep in epoxy resins subjected to axial loading over time periods of up to seven days.

cleaned or rejuvenated. Of particular interest was the work on Interstate Highway 80 east of Baxter, near the Whitmore Maintenance Station, where the extremely wet winter of 1963 produced two major slipout failures which closed the two eastbound lanes of the freeway for several months. In co-operation with District III, 9,500 lineal feet of horizontal drains were installed in the slide area. Large flows of ground water were intercepted which contributed greatly to the stabilization of the roadway. Two large stabilization trenches were designed.

The traveling deflectometer continues to prove useful as an instrument for determining the extent of repair needed to restore wornout roadways. The instrument was used to determine pavement deflections on 35 projects involving 150 miles. From the data obtained with the machine recommendations were made for reconstruction and thickness of the various roadway layers. During the year the machine was rented to the states of Washington and Oregon.

Sound-level studies were conducted at various freeway locations. In co-operation with the Highway Patrol continuing tests were made to evaluate muffler noise. Districts and several state agencies received assistance with other acoustical problems.

Research and Special Investigation

The research activities of the Department were numerous and broad in scope. Approximately 25 percent of the projects were undertaken to solve problems originating in other Division of Highways operating departments.

In co-operation with the Traffic Department studies were conducted to seek better methods for testing reflective materials; extensive tests of new traffic counters were performed; efforts to develop instruments to measure vehicle response to pavements were continued; and further impact tests were conducted to evaluate proposed design changes for median barriers.

In co-operation with the Bridge Department and the University of California instrumentation was provided for the Webber Creek Bridge on U.S. 50 to determine the effect of volume change, corner curling, and stress in steel. Projects were also initiated to study the stresses in a concrete bridge structure over Exposition Boulevard in Los Angeles and in a concrete arch culvert located on the San Luis Reservoir relocation. The arch culvert study included instrumentation of the fill so that pressures around and near the culvert might be determined.

Other projects included studies of ways to prevent corrosion of reinforcing and prestressing steel. Culvert installations using aluminum pipe were observed and evaluated. General research on electrochemical factors of corrosion was continued.

Further progress was made in the investigation of elastomeric bearing pads. Research concerning prestressed concrete fabrication practices was conducted with the co-operation of a local fabricator. Investigations were made to evaluate new methods of bonding concrete to steel in composite construction. Tests were performed to evaluate electroslag welding. The ultrasonic testing of welds was studied; work was continued on welding problems which might be encountered in the use of new low-alloy steels.

Research work on portland cement concrete included two test sections using expanding cement. Other work on concrete included the effects of air-entrained agents, the resistance to cracking, and the effects of other admixtures which have been placed on



This technician is conducting research experimentation on asphalt using the microductility apparatus developed by the Materials and Research Department. The apparatus measures ductility on small samples of asphaltic materials.

the market during the year. A technique for determining the air void system in hardened concrete has been adopted. Mortar tests have been carried on with the American Society for Testing and Materials. Work has continued on the evaluation of various types of pavement markers. Research was performed on paints and adhesives, including thermoplastic traffic paints and a new anticorrosive, inorganic zinc silicate paint for the protection of steel bridges in coastal areas.

A new method of measuring density and of determining maximum density and optimum moisture of soils has been developed and is currently being tested in the field. Studies to relate the effect of earthquake pressure and movements on deep pile footings are being carried on in co-operation with the Bridge Department and the University of California.

Another project being carried out for the department by the University of California involves the study of a method for predicting rock slides by listening to subaudible noise generated by incipient rock movements.

Testing techniques for the analysis of clay minerals and other substances have been developed for use with the X-ray diffraction apparatus.

A new tentative specification for paving grade asphalts has been devel-

oped and presented to the industry. Research is continuing on the development of a test method to measure the resilience of soils. Studies for determining the fatigue characteristics of asphalt concrete are being carried on for the department by the University of California. Work continues on the evaluation of commercial additives to asphalt concrete and several studies have been completed using hydrated lime and other stabilizing agents for the treatment of substandard soils and aggregates.

Training

Sixty Division of Highways engineers, eight Bureau of Public Roads engineers, and four county engineers attended the Materials and Research Department's training course, "Procedures, Testing Methods and Use of Materials for Highway Purposes." In addition to the four regular training courses, a two-day course was held for county materials and design engineers. Thirty-eight engineers attended from 26 counties. The laboratory continues to be popular with foreign engineers, as well as engineers throughout the country. The following tabulation of visitors shows the extent of interest in the work of the department:

168	Division of Highways engineers
9	Bureau of Public Roads and Highway Research Board engineers
38	county engineers
50	engineers from throughout the United States
83	foreign engineers, representing 28 countries
166	high school students and general public
39	engineering students (University of Nevada and Sacramento City College)
553	Total

EQUIPMENT

The primary responsibility of the Equipment Department is the acquisition, maintenance, and eventual disposal, when obsolete, of all automotive and construction equipment used by the Division of Highways. At the end of the 1962-63 fiscal year, 6,710 automotive (including all trucks) and 3,472 maintenance- and construction-type units were on hand.

The Equipment Department is financed by an equipment rental system whereby each department or district is charged a monthly rental for pieces of equipment used. Rentals are based on first cost, salvage value, repair cost, and a percentage of administrative overhead, and are subject to constant review to keep them realistic and appropriate.

The physical plant consists of 12 major shops and 17 subshops which serve the 11 highway districts. The state-owned toll bridges, and the Division of Highways headquarters. These shops also handle special work, such as maintenance and repair of movable-span bridges, pumping stations, ferry boats, light plants, and other items required by the Operations Department. Field forces accomplish emergency repairs on the road.

Research and Training

The technical research and training section investigates equipment operation and construction, fuels and lubricants, and preventive maintenance. The section prepares lubrication charts and maintenance manuals as part of the preventive program. An operating, maintenance, and repair manual was produced for the new cab-controlled traffic striping machine designed and manufactured at Headquarters Shop.

The section also supervised an extensive program of employee training. Special training programs given during the year included a shop mechanic course on alternators used on equipment, and operator training on mechanical features of equipment operation. Employees were encouraged to take training on their own time.

In 1953, a program for training operators of equipment in proper lubrication and preventive maintenance was established by the Equipment Department. This is being continued in co-operation with the Maintenance Department.

Equipment Design and Construction

It is the Equipment Department's responsibility to supply the Operating Department with equipment which will perform efficiently, safely, and economically. To meet these requirements, the Equipment Department is continuing to improve its operations, adding the latest types of equipment developed by industry, and planning, designing, developing and constructing of specialized items needed for the highway program.

The new concepts in overall roadway design as reflected in the routing, lane width, separated grades and landscaping are but a few of the factors that reflect the advance planning of the Division of Highways. These improvements require development of specialized equipment to maintain and service the finished projects.

An interesting example of this changing need is for more efficient snow removal equipment, brought about by the accelerated building of freeways and other multilane roads at the higher elevations.

The practice of allowing snowpack to develop on the roadway is being discontinued; thus it is necessary to remove the snow before a pack develops. Equipment which can remove snow at or near the speed of traffic flow and which will be able to handle increased volumes must be developed.

To take advantage of the more powerful engines now available in trucks, a wider, lighter, push-type plow has been designed and will be placed in service during the 1963-64 winter season. In keeping with the department's policy of standardization, the plow will be adaptable to all but the largest trucks.

Studies on the efficiency of existing large "C" type plows indicated that this equipment should also be redesigned for faster operating speeds. This was accomplished by reducing the weight of the plow and changing moldboard contours to achieve better casting characteristics.

Push-type plows are able to move large quantities of snow to the shoulder area but are unable to stack the material much over five feet in height. As this reef develops, rotary equipment is necessary to dispose of the accumulated snow.



This combination water tanker and roadside spray unit with cab-operated hydraulic spray boom is used for applying liquid fertilizers or soil sterilants.

Plans are being made to develop more efficient equipment for the reef removal phase of the operation. This will include improvements on existing rotary equipment as well as investigation of newer machines and the possible development of new concepts for snow removal.

Emphasis on landscaping and roadside improvement has increased requirements for equipment to maintain and control the vegetation. This includes watering, mowing, edging, and spraying, as well as disposing of the cut material.

Because of the attendant hazard to adjacent cropland, roadside sprayers must be designed to eliminate overspray as much as possible, and must be able to carry large quantities of material. To keep the equipment as versatile as possible, some water tankers are now equipped with spray booms, thus making them a dual-purpose item.

Various types of vegetation are used for ground cover and the prevention of erosion. One of the more popular is iceplant, which grows well in coastal areas. The plant does not require top cutting, but will grow over the curb and into the roadway. To control the overgrowth, an edger has been developed for curbside trimming. Current practice is to pick up and haul the cuttings; however, equipment to grind the material and deposit it back on the roadside is being developed.

Exploration drills are required to operate over unimproved terrain, yet must be able to travel at a reasonable speed between jobsites. To provide the flotation and traction necessary for the off-the-road function, the "duplex" tire is being used for the first time on trucks in this category. Several years of satisfactory use by private industry indicates that these tires are of considerable advantage on certain equipment.

Further improvements have been made to the highway paint striper, including a redesigned steering system, improved pushing attachment and the addition of an outrigger designed to paint lines at 4, 10, 11, 12, and 13 feet. This arrangement permits the painting of barrier lines while using lane lines as a guide. It also makes it possible to stripe seal coats using a previously applied dribble line at the roadside as a guide, thus eliminating the need for "cat tracking."

The addition of a system to transport the beads from the truck to the paint sulky has been made standard on all units. The elimination of the bead container on the sulky improves visibility for the operator, as well as increasing the bead capacity, eliminating frequent stops for bead replenishment.

The two-yard maintenance truck body has been discontinued in favor of a three-cubic-yard capacity body. The new body, although a full eight feet in width, permits the use of the same class chassis.

Improved truck-mounted asphalt heating tanks for the two-ton and four-ton dump trucks have been developed. The tanks use waste heat from the truck engine to warm the material by utilizing a heat exchanger in the tank. This has proven satisfactory, and has eliminated the problem of over-heating (as was the case using exhaust heat from the engine) as well as reducing the repair cost due to corrosion.

A 45-gallon bituminal tank was added to the four-yard maintenance truck which is used in areas where long distances exist between stocks. This tank has a built-in diesel oil tank of approximately five-gallon capacity, and diesel oil is used to flush the lines and hand gun. The air is taken from a compressor driven by the truck engine. Reports received on these units indicate that the combination is satisfactory.

During the past year, the Equipment Department has written specifications for 246 different types of equipment. Specifications are written in a manner to permit the various manufacturers to compete in bidding. A continuation of volume purchasing has resulted in considerable savings. During the past fiscal year, $5,927,514 was expended to purchase automotive and construction units as additional and replacement equipment.

The Equipment Department disposed of 1,030 obsolete units by sealed bids during the 1962-63 fiscal year for a total of $410,000, amounting to approximately 16.4 percent of the original cost of these units.

Procurement of Parts

During the 1962-63 fiscal year, the parts procurement section handled a total of 28,273 requisitions and purchase orders costing a total of $7,993,-

622. Volume purchasing and close attention to needs reduced the number of requisitions required to purchase material by approximately 1,000.

The intershop catalog, showing all critical and hard-to-obtain parts, has assisted in a reduction of inventory. It also has provided flexibility in sending parts when and where needed.

The Division of Highways has been granted a high priority for obtaining surplus items from the U.S. General Surplus Administration. By utilizing this procurement device during the past several years equipment and supplies have been obtained at a small percent of the original cost. In addition, it has been possible to obtain other surplus equipment which has been rebuilt and utilized by the Operating Department. This has resulted in a considerable savings in capital cost on these pieces of equipment.

The Equipment Department also inspects and licenses all of the division's pressure vessels and issues certificates permitting their continued use if in a satisfactory condition. In order to service units which have been added to the Division of Highways' inventory, it has been necessary to license additional inspectors, although no increase in personnel has been necessary.

Buildings and Plants

During the 1962-63 fiscal year, subshops at Burney in District II, at Fairfield in District X, and at Central Maintenance Station in Los Angeles were completed. The land acquired during the previous fiscal year for an equipment storage yard at Headquarters Shop, Sacramento, has been surfaced, fenced, and landscaped. Using this area for temporary storage has enabled the Equipment Department to utilize more fully repair areas which were previously required for temporary storage of equipment.

Funds have been allocated for the design and construction of the new Shop 3 at Linda since the existing shop, located in a rented building, is inadequate. Major repairs at present are handled either in Headquarters Shop at Sacramento, or in the Shop 3 subshop at Truckee.

The existing Shop 4 consists of a two-acre plant area which has been in service since 1920. The plant is too small, and there is no possibility of further expansion at that location.

Land was acquired during the 1961-62 fiscal year for a new Shop 4 in the City of San Leandro. Construction is tentatively scheduled for the 1963-64 fiscal year.

Statistical Section

The Equipment Department maintains a statistical section in its Headquarters Shop for interpreting cost and making adjustments in the rental rates of equipment. Rental charged to the Operation Department for the use of the various units provides the Equipment Department with funds for administration, depreciation, and repair of equipment. The latest revised rental schedule was placed in effect July 1, 1963. This method of accounting is approved by the Bureau of Public Roads and insures that the costs of equipment are fairly distributed to a particular road section or project.

Summary

Equipment Department operations over the past 10 years have grown with the increased workload of the Division of Highways. While inventory value has increased from $14,063,000 in 1950 to $36,718,000 as of June 30, 1963, personnel needs in the Equipment Department have increased only from 570 to a total of 692 in the same period.

EQUIPMENT DEPARTMENT SUMMARY

	June 30, 1962	*June 30, 1963*
Equipment repairs	$4,018,794.70	$4,426,936.80
Miscellaneous expense	645,884.61	659,914.06
Administration and other expense	1,047,247.95	1,210,311.00
Depreciation expense	3,361,477.72	3,912,864.82
Total expense	$9,073,404.98	$10,210,026.68
Total income	$9,163,801.60	$10,144,578.25
1962-63		$65,448.43

INVENTORY

Trucks and Passenger Vehicles

All trucks, ½- to 15-ton	$15,723,233.06
Buses, jeeps and station wagons	409,713.62
Passenger automobiles	4,166,027.83
Subtotal	$20,298,974.51

Maintenance and Construction Equipment

Motor graders	$4,614,585.67
Rotary snowplows (truck mounted)	1,654,605.76
Rotary snowplows (motor grader mounted)	131,649.71
Shovels, power	405,847.71
Loaders	2,262,026.22
Tractors	915,560.34
Snowplows, push	764,677.28
Compressors	375,395.96
Miscellaneous other equipment: rollers, mixers, trailers, pumps, drills, mowers, etc.	5,295,104.51
TOTAL	$36,718,427.67

Administration

The Assistant State Highway Engineer, Administration, exercises control over the following functions: office engineer; city and county projects; service and supply; management analysis; and systems research

OFFICE ENGINEER

The Office Engineer is responsible for a wide range of administrative activities including preparation, review and processing of plans, specifications, estimates, and bid and contract documents; budget and expenditure control; administration of federal funds; industry contacts; bidder prequalification records; reports and statistics; and mail and general files.

Budget and Project Control

Engineering control of the state highway budget involves procedures to insure that provisions and amounts specified in the budget are observed; preparation and processing of contract documents; preparation of financial documents submitted to the California Highway Commission; issuance of work orders; and maintenance of construction records.

During the year 451 financial votes were prepared for commission action; 545 projects were advertised for bids with an estimated cost of $353,163,700; and 501 projects were determined to be satisfactory for contract award.

In addition to the major contract work, the financing of 365 minor and informal contracts with a total value of $586,000 was cleared.

Plans and Estimates

Preparation of projects for advertisement requires reviewing and correlating the plans and specifications to assure that they are in agreement. Estimates of cost for all projects are reviewed periodically prior to opening of bids, and the estimates are adjusted to conform with prevailing construction costs whenever necessary.

Drafting personnel assigned to this unit prepare title sheets for the larger construction projects and location maps for many of the smaller projects; last-minute changes or additions are made to the detail plans for such projects prior to advertising; "as built" changes are placed on the contract plans; standard construction plans, three series of district and metropolitan area maps, various state maps including the road map supplementing the annual report of the division and the progress map, California freeway and expressway system, are prepared and maintained; charts and maps for other units and occasionally for other state agencies are prepared.

A monthly project record-consolidated status estimate, used in conjunction with the progress and payment of all regularly advertised going contracts, is prepared. Various other contract documents are reviewed or prepared. Monthly estimates, varying during the year from 250 to 400, are checked and processed. On June 30, 1963, there were 320 contracts valued at $568,489,800 under construction.

This unit also prepares material information handouts for use by prospective bidders.

Specifications

Specifications were prepared for 545 projects during the year. In addition, specifications were prepared for future projects to expedite advertising for bids when funds are available.

The Division of Highways Standard Specifications for highway projects, placed in use in January 1960, are being revised to include the latest improvements in construction methods and new materials and equipment. The revised specifications are expected to be published and go into effect in 1964.

Reports and Statistics

Statistical records were kept on 501 highway construction contracts awarded during this fiscal year. Records are kept for use in preparation of the quarterly California Highway Construction Cost Index, and for use in forecasting future materials requirements. Weekly and monthly reports for management purposes also are prepared, showing the value of budgeted and nonbudgeted programs, and of other projects for which bids are received. The statistical supplement to this annual report is compiled by this unit.

The contracts placed underway during 1962-63 covered a total of 1,260 centerline miles of state highway, including resurfacing. In addition, the Department of Public Works awarded contracts for construction on 167 miles of federal-aid secondary county roads.

Prequalification of Contractors

Prequalification is required of all contractors who bid on state highway projects estimated to cost more than $50,000. The prequalification rating, representing the maximum bidding capacity for each of the several types of work which a bidder is capable of undertaking, is established from a review of each contractor's statement of experience and financial condition.

The total number of contractors prequalified to bid on the various types of state highway construction decreased from 860 on July 1, 1962, to 835 on July 1, 1963. The combined bidding capacity of these 835 prequalified contractors is $2,532,881,000, which is $84,869,000 less than a year ago.

The following tabulation gives the number of contractors prequalified by the Division of Highways on July 1, 1963, arranged by the several brackets of bid ratings:

Rating		*Number of contractors*
[illegible] and over		83
5,000,000 to	$10,000,000	141
2,500,000 to	5,000,000	232
1,500,000 to	2,500,000	298
1,000,000 to	1,5[illegible]	355
500,000 to	1,000,000	517
250,000 to	500,000	681
100,000 to	250,000	[illegible]
50,000 to	100,000	835

Bids and Bidders

The average number of bidders per project during the year was 5.3, prac-

CONTRACT VALUE RANGE

Range	Number of projects	Percent	Value of projects	Percent
Under $50,000	234	46.7	$4,249,012	1.6
$50,000 to $100,000	62	12.4	4,301,026	1.7
100,000 to 250,000	80	15.9	13,188,699	5.0
250,000 to 500,000	45	9.0	16,029,671	6.1
500,000 to 1,000,000	23	4.6	17,444,986	6.6
1,000,000 to 2,500,000	21	4.2	28,934,441	11.0
2,500,000 to 5,000,000	24	4.8	90,695,405	34.4
Over $5,000,000	12	2.4	88,485,914	33.6
	501	100.0	$263,329,154	100.0

tically unchanged from last year's level of 5.4. The highest monthly average of 7.1 was in February 1962. The low of 4.1 was in August 1962 and June 1963. The contracts awarded during the fiscal year have been arranged in eight value ranges as shown in the accompanying "Contract Value Range" table. Included in the table are the number and total value of projects making up each bracket and the percentage each bears to the total.

STREET AND HIGHWAY MILEAGES

Various highway and street mileages, with which the Division of Highways is directly or indirectly concerned, are shown below:

	Miles	Miles
Total State Highway System (including portions of city streets and FAS System)		16,371
Highways proposed for construction where roads do not exist		2,206
Constructed state highways		14,165
Federal-aid System		
Primary rural (12-31-62)	8,113	
Primary urban (12-31-62)	1,592	
Total		9,705
Federal-aid Interstate System (included in above)		2,177
Federal-aid Secondary System (6-30-63)		
On state highways	3,457	
On county roads	8,836	
Total		12,293
County primary road system (6-30-63)	25,034	
Other county roads (6-30-63)	45,451	
Total county-maintained system		70,485
City streets (estimated 12-31-62)		32,915
City streets on state highway system		1,797

Construction Cost Index

The California Highway Construction Cost Index is founded upon weighted average contract prices for seven principal construction items in place, all referred to the base year of 1940 with a value of 100.

The fiscal year began with a new high index value of 289.1 in the third quarter of 1962, dropped to 232.6 in the following quarter, increased again to 250.4 in the first quarter of 1963 and dropped slightly to 243.7 in the second quarter of 1963. The average value for 1962 is 256.2.

The accompanying graph shows a comparison between the California Index, the Bureau of Public Roads Index and the Engineering News-Record Construction Cost Index. The latter two indices are based on nationwide construction costs and do not reflect the pronounced rises and falls to be found in an index where local conditions are a controlling factor, as in the California Index.

CONTRACTS BY TYPE

This tabulation gives the number of contracts with mileage by types awarded during the 1962-63 fiscal year.

Number of contracts		Centerline miles
26	Portland cement concrete	127.5
174	Asphalt concrete	803.7
6	Road mix	66.1
8	Seal Coat	255.9
2	Grading	7.2
85	Traffic signals and lights	...
27	Bridges	
104	Miscellaneous	
432	Total	1,260.4

NOT ON STATE HIGHWAY SYSTEM

County Roads—Federal-Aid Secondary

Number of contracts		Centerline miles
39	Asphalt concrete	148.9
2	Road mix	9.3
2	Seal Coat	3.6
4	Grading	9.0
3	Bridges	
16	Miscellaneous	
66	Total	170.8

STATE HIGHWAY MILEAGE BY SURFACE TYPE

TYPE	NORTH			SOUTH			TOTALS		
	Outside cities	Inside cities	Total	Outside cities	Inside cities	Total	Outside cities	Inside cities	Grand total
Concrete	526.287	169.310	695.597	566.777	400.702	967.479	1,093.064	570.012	1,663.076
High bituminous	4,256.773	505.724	4,762.497	3,439.793	614.298	4,054.091	7,696.566	1,120.022	8,816.588
Low bituminous	1,438.225	28.177	1,466.402	865.166	11.521	876.687	2,303.391	39.698	2,343.089
Oiled earth, gravel	515.005	0.714	515.719	600.372	4.329	604.701	1,115.377	5.043	1,120.420
Graded and drained earth	38.345		38.345	17.684		17.684	56.029		56.029
Bridges	70.578	33.761	104.339	33.161	28.636	61.797	103.739	62.397	166.136
Totals—constructed road	6,845.213	737.686	7,582.899	5,522.953	1,059.486	6,582.439	12,368.166	1,797.172	14,165.338
Unconstructed road	1,156.374	143.163	1,299.537	683.646	222.945	906.591	1,840.020	366.108	2,206.128
Total highway system	8,001.587	880.849	8,882.436	6,206.599	1,282.431	7,489.030	14,208.186	2,163.280	16,371.466

STATE PARKS, ETC.

Number of contracts		*Centerline miles*
3	Miscellaneous	

Federal Aid

A total of $305,256,138 in federal-aid funds was apportioned to California for 1963-64 under the Federal-aid Highway Acts of 1961 and 1962. This included $21,652,107 for primary highways, $10,013,735 for secondary routes, $25,672,496 for urban routes and $247,917,800 for interstate highways. The federal matching ratio on primary, secondary and urban projects is 59.62 percent. On interstate projects the federal ratio is 91.56 percent.

At the start of the fiscal year, construction was in progress on 109 contracts with a total cost of approximately $489,463,000, financed with federal-aid primary, urban and interstate funds in the amount of $374,944,000.

Eighty-one construction contracts involving $16,133,000 of primary funds, $26,764,000 of urban funds and $150,540,000 of interstate funds were completed during 1962-63. These amounts, together with the required state matching funds, bring the combined total cost of such improvements completed during the year to approximately $250,369,000.

Eighty-five contracts were awarded with a total cost of $217,112,000, involving primary, urban and interstate federal-aid funds totaling approximately $166,094,000. Fifty-seven of these contracts provide for improvements on the National System of Interstate Highways with a total cost of $142,129,000 of which the federal share amounts to $127,160,000.

Right-of-way project agreements with the Bureau of Public Roads increased the total of interstate federal-aid funds obligated for participation in right-of-way acquisition costs by $82,460,000 to a total of $440,271,000.

Industry Contact

The industry contact section obtains prevailing wage contract data from contractor and labor organizations; collects information for the establishment of equipment rental rates to be used on force account work; represents the division at hearings of the California Public Utilities Commission concerning dump truck rental and asphalt hauling rates; and processes minor contracts, right-of-way clearance contracts, informal bid and emergency contracts, and service contracts.

Service Contracts: 4,900 service contracts were processed involving a total expenditure of $6,771,000.

This type of contract is used for renting equipment and obtaining a wide variety of services. Its use is confined to work not covered by the State Contract Act and not adaptable to other prescribed procedures.

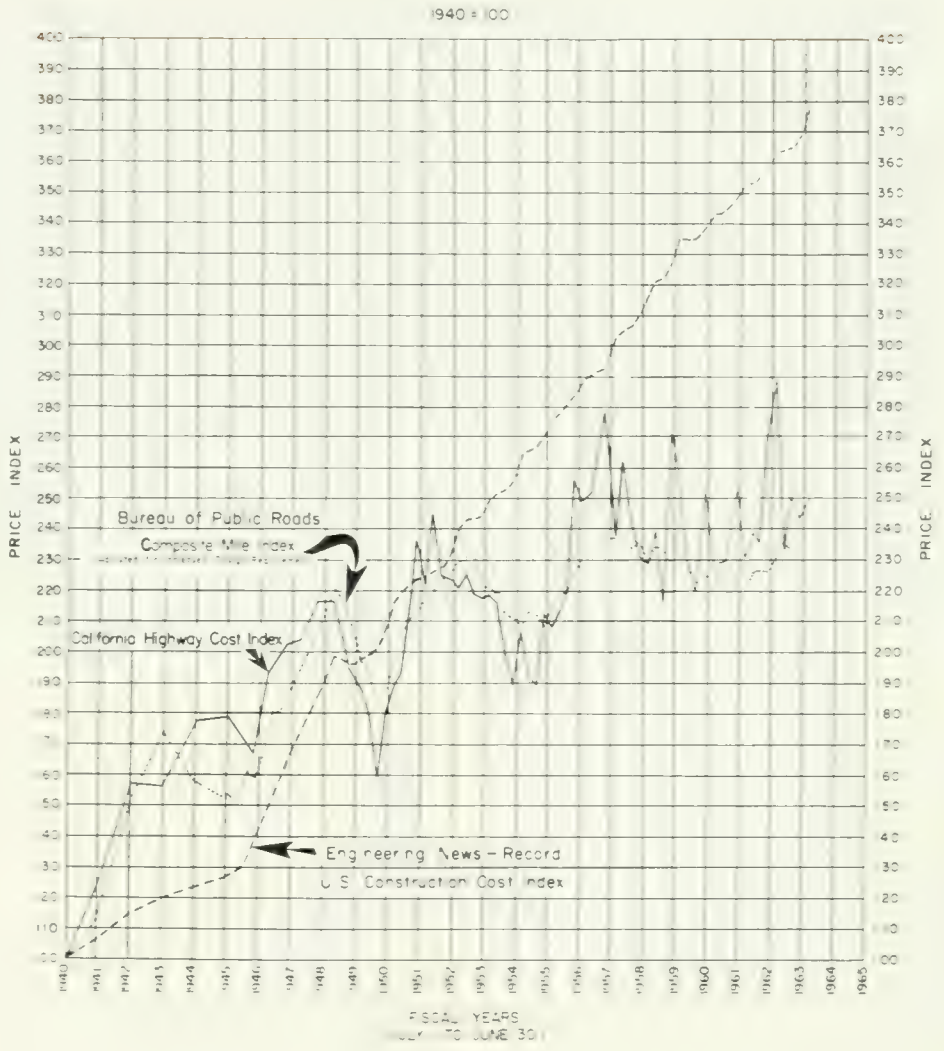
The principal use of service contracts, involving an expenditure of nearly $2,461,000, was for the rental of equipment for highway maintenance, for honor camps, and for occasional day labor projects.

Minor Contracts: Small projects for which the cost will not exceed $5,000 are handled by the districts. A total of 365 minor contracts with a value of almost $586,000 were awarded during the fiscal year, an average per contract of approximately $1,600.

Standard Agreements: Certain types of personal services are obtained under standard agreement. During the fiscal year 102 standard agreements were processed covering such services as appraisers and expert witnesses in right-of-way matters and professional consultants in unusual design and economic investigations.

Right-of-way Clearance Contracts: Contracts awarded to clear rights-of-way in advance of construction included. 477 contracts totaling $724,000 for the demolition of buildings; and 21 contracts totaling $507,000 for altering and moving buildings, relocating irrigation systems and drilling wells.

PRICE INDEX
CONSTRUCTION COSTS



CITY AND COUNTY PROJECTS

Liaison activities in connection with city and county co-operative projects are handled by a unit at headquarters under the Assistant State Highway Engineer, Administration. The head of the unit is titled "city and county projects engineer." There are counterparts in each of the 11 district offices and the Bridge Department.

In addition to the administration of the five-eighths cent of the gasoline tax that is apportioned to the cities, this unit handles liaison activities between the U.S. Bureau of Public Roads and the counties in regard to federal aid secondary projects. This unit also performs administrative and engineering functions concerning county and city construction projects on urban extensions of the FAS system, and flood damage repair projects on the local road and street systems. In addition, it keeps the county road mileage records necessary for the State Controller to apportion funds to the counties from the Highway Users Tax Fund.

(As of September 20, 1963, a select system of city streets and county roads superseded the major city street and county primary road systems under provisions of Senate Bill 344, which provides additional revenue for city streets and county roads.)

City Projects

The Streets and Highways Code provides that five-eighths-cent tax per gallon of gasoline sold shall be allocated annually by the California Highway Commission from the State Highway Fund for expenditures on city streets, on the basis of each city's percentage of the total population of all cities in the State.

The code also provides for the annual allocation by the commission of amounts ranging from $1,000 to $20,000 to each city for engineering costs and administrative expenses in respect to city streets. Since 1961 the code allows cities of less than 10,000 population to use some of these funds for construction.

Funds Budgeted

A total of $46,263,944 was budgeted for city projects during the fiscal year; including $26,809,335 for surveys, plans and construction; $8,928,347 for rights-of-way; and $11,526,262 for maintenance. Funds allocated for engineering and administration amounted to $1,284,500.

State-allocated (five-eighths-cent) funds available to cities for budgeting during this fiscal year were:

Unbudgeted funds in city treasuries and in the State Highway Fund, June 30, 1962	$10,927,652.29
Apportionments during the fiscal year	36,895,189.81
Savings on completed projects and canceled projects and interest and rental receipt accruals	7,374,275.17
Total available for budgeting during the fiscal year	$55,197,117.27
Actual amount budgeted	46,263,944.43
Carryover for budgeting in the 1963-64 fiscal year	8,933,172.84

Major City Street Systems

Each city council is required by law to select a system of major city streets subject to approval of the Department of Public Works. At least three-fifths of the state-allocated (five-eighth-cent) funds must be spent for the construction of streets included in these systems. The remainder of these funds may be spent for the maintenance of any city street.

Master plans being developed by many cities and counties provide a good basis for the selection of these major streets by city councils. During this past year, many cities updated their major city street systems.

During the year, 547 sets of plans, specifications and estimates were reviewed and approved for construction. These plans provided for the improvement of 200 miles of streets at an estimated cost of $31,695,380. To further assist the cities by reducing the time required for plan reviews, the responsibility for the review of routine plans was delegated in January 1963 to each of the districts.

Population Figures, New Cities

Populations of cities, upon which apportionment of state-allocated funds are based, are determined from United States regular or special census figures, modified periodically by estimates of the State Department of Finance and by annexations and incorporations.

The total estimated population of the 382 incorporated cities at the end of the fiscal year was 12,517,780, or approximately 70 percent of the estimated 17,675,000 total state population. The population in cities increased 539,305 during the fiscal year.

There were 1,093 city annexations during the fiscal year. Five new cities were formed by incorporations. The new cities, with dates of incorporation and estimated population, are: Palmdale, Los Angeles County, August 24, 1962, 10,479; Rohnert Park, Sonoma, August 28, 1962, 2,775; Victorville, San Bernardino, September 21, 1962, 8,259; San Marcos, San Diego, January 28, 1963, 2,991; and Vista, San Diego, January 28, 1963, 20,373.

The FAS Program

A major change in the scope of the Federal-aid Secondary Highway Program occurred when the Federal-aid Highway Act of 1962 became law on October 23, 1962. Under this law, California became eligible to expend any of its federal-aid secondary funds within urban areas.

During the 1962-63 fiscal year, 620 miles of county roads and city streets were added to the Federal-aid Secondary System. Most of the increase is attributable to major system revisions in the Counties of San Bernardino, Riverside and Merced. Approval of a major revision in San Diego County was pending at year's end and system studies were being conducted in at least eight others.

While the local system was being expanded, the state highway portion of the FAS system was being decreased 464 miles, reducing the net gain to 156 miles. Virtually all of the decrease may be attributed to transfers of routes to the Federal-aid Primary System.

As of June 30, 1963, there were 12,293 miles of FAS routes, including 8,836 miles on county roads and city streets.

Forty-nine county FAS contracts were awarded during the fiscal year at a total cost of $15,282,279. These



This recently completed widening of Bellevue Road between Buhach and Shaffer Roads in Atwater, Merced County, was financed with federal, state, county and city highway user tax funds.

funds covered construction on 166.721 miles of road and 15 bridges.

Of the federal funds for secondary highways, authorized for the 1963-64 fiscal year, California received $10,013,735. In accordance with state statutes, 87½ percent or $8,762,019 was reapportioned to the counties. The Division of Highways retains 11 percent of the total allocation for construction on FAS state highways and 1½ percent for planning purposes.

A total of $4,151,028 was provided from the State Highway Fund in accordance with State law to pay the counties' share of the FAS construction projects up to a maximum of $100,000 per county.

The Urban Extension Program

Since 1959 state highway funds have been provided on a matching basis for improving city and county urban extensions of the Federal-aid Secondary System. Selected urban area projects adjacent to others in the contiguous rural area were approved on the basis of anticipated traffic volumes qualifying the sections for development to multilane divided status.

The status of the FASUE program may be summarized as follows:

Fiscal year	*Projects*	*State Funds*
1960-61	5	$861,250
1961-62	10	1,352,789
1962-63	4	376,800
1963-64	9	2,023,925

Twelve projects have been completed, seven are underway and nine are being readied for contract. The 1963-64 fiscal year includes one project utilizing $973,425 of state funds that was carried over from the 1962-63 fiscal year. As of June 30, 1963, 11 additional applications for $3,250,850 in state funds had been received.

The state funds involved in the above 39 projects (including the 11 in the application stage) are segregated as follows: cities $3,317,934, counties $4,547,680.

Flood Damage Repair Program

All projects for which funds were allocated to local agencies according to the 1959 Emergency Flood Relief Law and the Budget Act of 1960 have been completed, with two exceptions. Of the two, one is virtually complete and the other has been suspended pending right-of-way litigation. All projects on prior programs have been completed. Work on local government projects for which funds were authorized by Item 13.6 of the Budget Act of 1962 is proceeding and it is anticipated that these projects will be completed about the end of 1963.

The storms of October 1962 and those of late January and early February 1963 caused extensive damage to roads, streets and bridges in the northwest coastal counties, mountain areas, and in cities and counties around the northern portion of San Francisco Bay.

A "state of disaster" proclamation by the Governor resulted in federal financial assistance being made available by Public Law 875 and the Emergency Relief provisions of Title 23. Public Law 875 funds reimbursed the local agencies for emergency measures to maintain or restore essential public real property damaged by both storms. Federal-aid emergency relief funds were made available toward costs of emergency repairs and the restoration of federal-aid highways damaged by the 1963 storms. State funds activating the Emergency Flood Relief Law to assist local agencies in restoration of damage by both storms were made available by the Legislature through Chapter 81, Statutes of 1963.

At the end of the fiscal year 10 counties, 6 cities, and 2 special districts had applied to the Department

of Finance for a total of approximately $7,400,000 state assistance in the costs of restoration of streets, roads, and bridges. The Division of Highways investigated all street and highway damage and at the close of the fiscal year were filing reports for transmittal to the Department of Finance. By an agreement with the California Disaster Office, engineers of the division also investigated claims of 34 local agencies under Public Law 875 totaling $1,165,471.

County-maintained Roads

Although there were five newly incorporated cities and 1,093 city annexations during the fiscal year the county maintained road mileage increased 457.44 miles during the year to a total of 70,485.13 miles. A total increase of 438.82 miles of county primary roads were approved by the department and the new total is now 25,033.52 miles.

SERVICE AND SUPPLY DEPARTMENT

Since its inception in 1947, the Service and Supply Department has provided many accessory services necessary to the operation of the overall state highway program.

Service

Reproduction—New procedures and equipment are being employed to further the efficiency and utility of this section in headquarters. The blueprint unit processed 7.5 million square feet of prints. The duplicating unit ran 100,000 masters for 15,000,000 impressions.

Many districts as well as headquarters are using the electrostatic photocopying machines that are capable of turning out multiple dry copies rapidly. The convenience and speed of operation of these "automatic" type of duplicators has brought about a decided change in the duplicating habits of the division. A study is being made to ascertain the degree of control necessary for the efficient and economical operation of these machines.

Photography—Headquarters photographic lab processed 1,933 orders (up 18 percent from last year). The orders have more than doubled in the last four years. Changes are now in progress to streamline methods of billing departments and other agencies for photographic services. In order to meet the growing needs for motion pictures, color pictures, and aerial photos consideration is being given to the expansion of facilities.

Record Management—There are 19,427 cubic feet of records now in storage in the Sacramento warehouse, an increase of 6 percent over last year. There were 18,306 references to these records. Two thousand four hundred fifty-five cubic feet reached the destruction period and were sold as scrap paper.

The north record center is now moving into its own building at the Sacramento warehouse site. The south record center has reached its capacity of 4,200 cubic feet of records and provision is being made to increase its size.

Business and Building Services, Property and Building Management—This "housekeeping" function covers many areas. As an example, a study was made to analyze the water used in various districts and headquarters. Reports and recommendations are then supplied to each facility. This enables each facility to treat its water supply so as to eliminate scale and corrosion. The resulting greater efficiency and longevity of equipment will effect large long-range savings to the division.

The review of all requests for service contracts at one central point and comparison of prices in similar areas has resulted in substantial savings, especially in repair of office machines and equipment.

Supply

Procurement—Service and Supply is charged with procuring necessary items at the lowest possible ultimate cost. In order to achieve this objective, the proper choice between direct purchases, local purchases, and warehousing must be exercised. In order to eliminate the additional cost of warehousing, local and direct purchasing have been emphasized where practicable.

In the beginning of this fiscal year, the Department of Finance severely restricted the use of blanket purchase orders for local purchases. In order to minimize the effect of this restriction, the following two procedures have been implemented. (1) Service and Supply successfully petitioned through the Department of Finance to have the limit on cash purchases raised from $4 to $10. This cash purchase procedure saves considerable time and simplifies recordkeeping. (2) The use of a subpurchase order pad for local purchases is being implemented throughout the division. A pilot test in Districts II and IV has proved successful. The use of this pad will eliminate the need for the local request, the district subpurchase order, the vendor's bill, and the receiving record, thereby substituting one document for four.

As a result of the change in emphasis, warehouse purchases were down 9.8 percent to $5.1 million. Other purchases were up 7.2 percent to $10.4 million. Total purchases were up to $15.5 million as compared to $15.4 million last year. Warehouse disbursements were down 9.3 percent to $5.2 million. Warehouse inventories were down 4 percent to $2.2 million.

Warehouse Operations—In order to expedite the continuing efforts to reduce warehouse inventories, Bridge Maintenance reviewed their needs for steel H piling and beams stocked several years ago to meet emergency needs. As a result, most of this steel has been earmarked for use as state-furnished material on bridge contracts.

There were 34,493 requisitions filled for a total of 117,701 items at the warehouse. This required 14,192 shipments.

In a manner similar to the critical approach used in determining whether items should be stocked in the warehouses, the markups have been reviewed and reduced. The sign markup has been reduced from 10 percent to 6 percent and other items are being reduced accordingly. The overall warehouse markups for June 1963 averaged under 12 percent as compared

pared with 15.4 percent last year. This markup finances office expenses, part of the procurement costs, as well as warehousing, packaging, and freight costs along with costs incurred in disposing of obsolete items.

A contributing factor in the reduction in markups is the growing efficiency of the warehousing operation. For example, more and more items are being palletized, which expedites movement and allows higher stacking with a resulting gain in warehouse area utilization.

Signs—The sign procurement program has been thoroughly investigated to insure that the methods used are in the best interests of the State. It is tentatively planned to reduce the size of the major sign contract by division into smaller contracts. This will encourage competition. Also discussions have been held with other departments to improve the packaging, shipping, and storage of signs, to insure that sign damage is minimized. The warehouses handled 67,642 signs costing $1,726,000.

Nonrental Budget—The budget for 1962-63 nonrental equipment as submitted to Service and Supply for review was $1,512,000. The revised budget in the amount of $1,000,000 was approved, with an additional $100,000 in the work order reserved for contingencies. The actual expenditures during this fiscal year totalled $891,000. The nonrental inventory as of June 30, 1963, was $15,229,000, up 2.3 percent from the previous year.

Printing—There were 2,568 printing orders processed for the Office of State Printing. In addition, over 150 orders were cleared with the State Printer for accomplishment by private firms.

Co-ordinators—In addition to their manifold liaison duties, the two co-ordinators made a special effort to help the districts dispose of obsolete and surplus material through sales and transfers. This is part of the special effort being made throughout the Service and Supply Department to dispose of all obsolete and surplus items.



Shown is a freeway section of U.S. 50 west of Placerville completed in September. An expressway section west of Camino and a 5.5-mile freeway near Pollock Pines on this route will be completed in 1964.



Palletized stakes, bin and hubs stored at the Division of Highways warehouse in Sacramento

MANAGEMENT ANALYSIS

The Management Analysis Section undertakes surveys and makes reports at the request of operating departments within the division. Therefore, those projects completed or undertaken during the past year will be only briefly mentioned here, leaving a more detailed description of each study to the requesting department itself.

A study was made to determine whether or not to charge fees for permits for extralegal loads and encroachments on state highways.

In co-operation with the Systems Research Engineer further research has gone into developing and refining work standards to serve as a guide in making manpower projections.

A study for the Materials and Research Department, conducted jointly with the Accounting Systems Section, developed an improved accounting system. Workload guides were developed which will make it possible to estimate future needs more accurately as well as manage day-to-day operations.

A study was made which resulted in an improved distribution of mail within the headquarters office.

Two comprehensive, long-range studies were also begun. The aim of the first study is a more accurate and uniform definition of what should be charged as an administrative expenditure. The second study, conducted in co-operation with the Personnel and Accounting staffs, will work toward developing a more comprehensive personnel and operating expense budget process which could also be extended to the 11 highway districts.

The Management Section also aided in furnishing and gathering information for an outside consulting firm retained by the division to determine ways and means of increasing efficiency through the use of electronic data processing.

During the past year further progress was made on records usage studies for 4 more of the 11 highway districts. These studies are designed to reduce the cost of recordkeeping, save office space, establish uniform filing procedure and provide a plan for handling operations which will require additional space in the coming years.

Savings of more than $49,000 were realized from the divisionwide records program. Nearly a third of these savings resulted from a thorough survey of requests for additional filing equipment.

Continued progress was made in a pilot map study which will provide some ground rules for a systematic review of maps and plans so that obsolete and superseded ones can be removed from the files.

A study of general services functions is being carried on at the request of one of the highway districts with a view to improving the level of such service within reasonable cost.

SYSTEMS RESEARCH

The position of Systems Research Engineer was established in 1961 to study, report and make recommendations concerning the division's engineering costs, production, systems and staffing.

Initial attention has been given to segregating and identifying engineering cost centers through detailed study of the division's coding procedures. Cost data for the 1961-62 fiscal year in the functional areas of planning, design, construction and right-of-way were compiled and discussed with each district to emphasize the need for more accurate recording by employees on input data and source documents and the concurrent need for reduction of charges made to the "undistributed" accounts in each of the primary functions of expenditures.

A revision of the division's Coding Manual was undertaken for better definition of engineering effort areas.

Work was started on delineation of charts showing the relationship of manpower to funds expended or programmed in each district in the areas of preliminary engineering, construction engineering, right-of-way and "other" expenditure groups.

In October 1962 a private consulting firm was engaged to study the manpower and fiscal procedures of the division's electronic data processing operation. For analysis of recommendations made by the consultants, a Division Evaluation Committee was established by the State Highway Engineer at the Assistant State Highway Engineer level. The Systems Research Engineer furnishes liaison and is rendering staff assistance to the committee during the progress of this management survey.

Planning

The Assistant State Highway Engineer, Planning, is in charge of advance planning, programs and budgets, design, traffic, and urban planning

ADVANCE PLANNING

The Advance Planning Engineer is in charge of the Advance Planning and the Photogrammetric Units.

The Advance Planning Section is responsible for processing project reports, co-ordinating route adoptions and freeway declaration procedures, processing freeway agreements, and co-ordinating the Division of Highway planning work with that of other state, federal, or local agencies.

Project Reports

Project reports for 278 proposed projects were processed during the year, 182 of which were major projects.

A project report covers the engineering investigation and analysis of a specific project. This report discusses the need for and the type of the planned highway improvement and how it should be accomplished.

Project reports are required for all proposed improvements. They constitute a control mechanism in planning and budgeting, and provide information for basic design features. They are prepared within the district offices.

The reports are reviewed at the Sacramento headquarters where analysis by various departments is coordinated by the Advance Planning Section after field review. This analysis insures an orderly development of surveys and plans.

Aerial mapping is being used more and more to evaluate topographic controls and expedite the preparation of project reports.

Freeway Routes

Emphasis has been placed for many years on the development of an *integrated system* of freeways. It involves consideration of community values and potential land uses, as well as traffic needs and benefits.

The Division of Highways informs local authorities of the initiation of freeway route studies and of the general features of proposed freeway units as the studies progress. When sufficient information has been developed on a specific freeway project, a well-publicized public hearing is held in the general area to present the results of the study to local officials and the interested public and to learn the local reaction to the project plus any information which may be pertinent to the routing. (Current commission procedural policy, which is contained in subchapter 4 of the California Administrative Code under which the Division of Highways operates in freeway route location matters, is included in the statistical supplement of the annual report.)

Transcripts of proceedings of public hearings, together with reports on the results of conferences, are made available to the Highway Commission for consideration in the determination of freeway routings.

During the 1962-63 fiscal year, the district staffs of the Division of Highways held 51 of these formal public hearings to discuss proposed freeway routings. A number of conferences with city and county officials and their technical staffs were also held, as were several hundred preliminary informational meetings and map displays. The California Highway Commission itself also held 10 public hearings during the year, 7 at the request of the local authorities and 3 on its own initiative. (The public hearings held by both the Highway Commission and the Division of Highways are listed in the statistical portion of the annual report.)

The California Highway Commission had under consideration during the year some 69 freeway projects and adopted routings on 60 of them. These adoptions increased the freeway mileage 419.3 miles, making a new statewide total of 6,622.7 miles of declared freeway as of June 30, 1963.

Looking southward along the James Lick Memorial (Bayshore) Freeway from above the Southern Freeway Interchange in San Francisco.



Freeway Arrangements

Close co-operation between the State and cities and counties resulted in working out and concluding 171 freeway agreements during the year. In some cases, original agreements were replaced by supplemental agreements which incorporated improved design standards or provided for changes in traffic patterns or local planning.

Interstate Highway System

Approval of the U.S. Bureau of Public Roads is required on the final locations of all routes on the Interstate Highway System. This is done for each interstate section after adoption by the Highway Commission.

At the end of the year, the locations for approximately 2,097 miles, about 96 percent of the Interstate System in California, had been approved. This leaves only approximately 72 miles of interstate routing yet to be approved, and 45 miles of this is now under active consideration.

National Forest Highways

The Division of Highways acts jointly with the U.S. Bureau of Public Roads and the U.S. Forest Service in an annual improvement program on California roads designated as forest highway routes. The forest highway network in California covers approximately 2,580 miles, about 77 percent of which is on state highway routes.

The California apportionment of forest highway funds for the 1962-63 fiscal year was $4,726,004. Including funds remaining from previous apportionments, the distribution of forest highway money in the State as agreed upon by the three agencies were as follows: projects on state highways, $5,360,000; projects on county roads, $200,000; system surveys, $250,000.

The Bureau of Public Roads plans, designs, advertises and supervises the construction of federally financed forest highway projects. For projects on state highways, the Division of Highways works with the bureau in the planning and design phases and also obtains the required rights-of-way, including clearance of utilities and options on material sites.

PHOTOGRAMMETRIC MAPPING AND AERIAL PHOTOGRAPHY

Aerial photography is an important aid in advanced planning, design, right-of-way, and traffic studies; it is used to some extent in other phases of the highway program.

Photogrammetric mapping is frequently used during the advanced planning phase in conjunction with the study of possible alternate routes, and is used on most projects for the location and design of adopted routes. Most of this work has been obtained by contract, although a portion of it has been done by the Photogrammetry Unit.

Following is a resume of expenditures for contracts completed during the fiscal year:

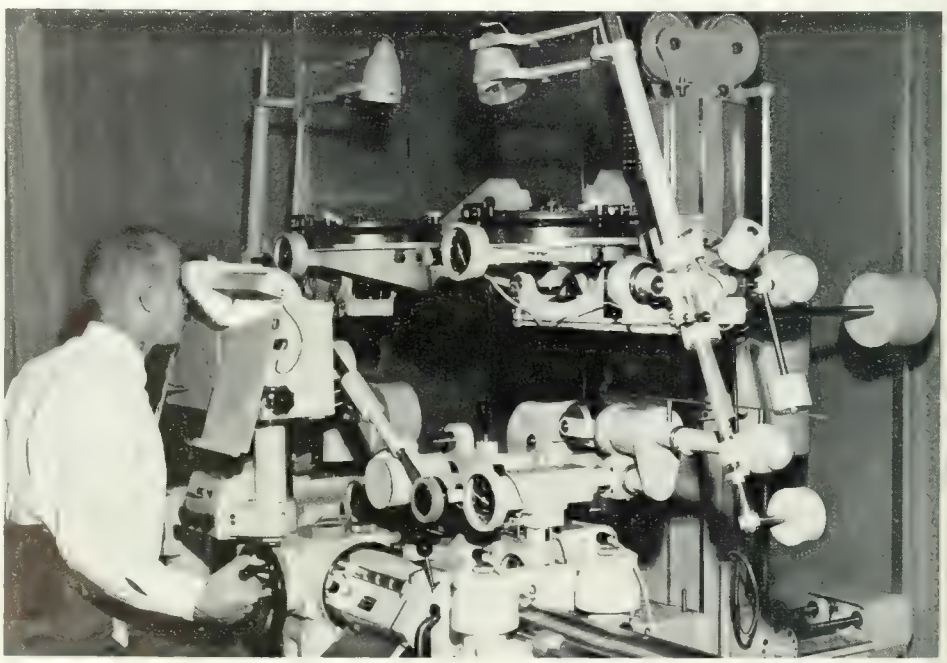
	Contracts	*Highway strip miles*	*Contract amount*
Contour mapping projects for design	16	119.9	$164,677.60
Contour mapping projects for reconnaissance	3	53.2	32,618.00
Stereoplotter rental contracts	26		199,872.65
(Compilation for design)		318.4	
(Compilation for reconnaissance)		111.6	
Aerial photography contracts	19		58,060.01
Aerial photography contracts (blanket)	11		117,063.57
Total			$572,291.83

Another important activity is the taking of photogrammetric cross-sections for particular construction projects. The cross-section data are automatically recorded on punch cards by means of an electronic attachment to a stereoscopic plotting instrument. Five projects, a total of about 28 miles, have been completed this year.

Precision aerial photography of the terrain prior to construction provides a permanent and valuable record which can be referred to anytime after construction has commenced. For this purpose it is necessary to premark or target the staked centerline, or its equivalent, before the photography is taken to insure positive identification of the line.

Developments

Two instruments of significant importance were acquired which permit a greater flexibility of photogrammetric procedure.



The stereoplanigraph, a plotting instrument of great versatility and accuracy, is used for establishing photo control, both vertical and horizontal, by aerotriangulation.

One instrument is known as a *coordinatograph*. This is a precision instrument for plotting points according to X and Y co-ordinate values, which can also be used for plotting grid sheets. The accuracy of plotting is about 0.001 inch for individual points. The instrument is now in continuous use for the preparation of photogrammetric map manuscripts, and for the plotting of centerlines prior to the taking of photogrammetric cross-sections.

The second instrument is a *stereoplanigraph*. This is a precise photogrammetric plotting instrument of great versatility and accuracy. In the hands of a skilled photogrammetrist, the instrument is capable of being used for establishing photocontrol, both vertical and horizontal, by a procedure known as aerotriangulation, or sometimes called bridging. The instrumental data produced are in the form of X, Y, and Z co-ordinates for particular points, and the final data are adjusted by an electronic computer program utilizing the principles of least squares.

Another use for the instrument has been developed with the assistance of the District IV Right of Way Department in connection with determining final right-of-way lines. The original research was financed under federal-aid 1½ percent highway planning and research funds. Two projects utilizing this research have been completed this year.

Map Checking

About two-thirds of the total mapping mileage obtained by contract is reviewed photogrammetrically. This is an established service which provides advanced information to the districts as a guide for performing accuracy test surveys by field methods.

Geodetic Distance Measurement

Recent technical developments permit the use of geodimeter equipment as a daylight instrument whereas hitherto it has been strictly a nighttime operation. Five state-owned nighttime operated instruments have been converted to daylight operation. The division now has a total of nine instruments, seven of which can be operated day or night.

Special Project

A contract between the U.S. Coast and Geodetic Survey and the Division of Highways was effected for a geodetic control survey of the San Diego metropolitan area. The purpose of the survey is to establish correct geodetic positions of the intersections of many state highways in this area, and is expected to reduce confusion in future development of the highway routings. The fieldwork is being performed by state forces, and all computations and adjustments will be handled by the Coast and Geodetic Survey.

PROGRAMS AND BUDGETS

The Programs and Budgets Section is responsible for co-ordinating the development of statewide long-range planning programs, preparing the annual state highway budget, scheduling and controlling the advertising of construction projects, maintaining a constant check on the present and future availability of funds, and administering the buildings and plants program.

Planning Programs

Planning program development is a continuing process formalized annually to reflect current data with respect to highway needs, availability of funds, and legislation.

The annual planning program is prepared by each district office for its area. These district programs are carefully reviewed by affected headquarters departments for conformity with established controls and continuity on a statewide basis.

The district programs as adjusted and combined become the formal statewide planning program and are presented to the California Highway Commission for review. The planning program is the guide by which the division's efforts are directed in administering the highway program.

Annual State Highway Budget

The annual state highway budget is prepared using the latest planning program as a guide to project priorities. Many factors must be carefully analyzed to insure the most efficient use of funds. Estimates of revenue from both state and federal sources are made after consultation with other agencies involved.

After allowance for the operating needs of the division, the remaining funds estimated to be available are allocated to specific construction and right-of-way acquisition projects, in accordance with applicable legislative controls, to best serve the needs of traffic and the overall economy of the State. The responsibility for final adoption of the annual budget rests with the California Highway Commission.

The 1962-63 fiscal year budget included approximately $658,000,000 of which approximately $287,000,000, or 44 percent, represented federal-aid apportionments. The budget included nearly $460,000,000 for construction and right-of-way acquisition, providing 255 miles of multilane freeway, 23 miles of multilane expressway, 110 miles of two-lane expressway and 108 miles of conventional highway.

Advertising Schedules

Since California's highway program is operated on a pay-as-you-go basis, careful scheduling of expenditures is necessary to insure solvency of the State Highway Fund.

Revenue comes from two sources, state highway-user taxes and fees and federal-aid subventions. User taxes are received monthly and motor vehicle fees annually, and can be estimated rather accurately. Federal-aid revenue is received on a reimbursement basis and is therefore dependent on the rate at which projects which are financed in part with federal funds are placed under construction. Great care must be exercised to maintain a balance between federal-aid and regular state highway projects to insure that expenditures do not exceed revenues.

To maintain a steady flow of construction work throughout the State and thus make the most efficient use of both state and contractors' personnel, the Programs and Budgets Section maintains a close liaison with the various district offices to co-ordinate the many functions necessary to eliminate delays in completion of plans, acquisition of right-of-way and clearance with other agencies.

Buildings and Plants Program

During the fiscal year, construction was begun on a new branch laboratory for the Materials and Research Department at Los Angeles and an addition to the District I office building in Eureka. Funds were provided for acquiring additional land for expansion of the District VII office building at Los Angeles, the District XI office building at San Diego, and for the construction of a District VII laboratory building at Los Angeles. Maintenance stations at Kyburz, Tarzana, McGee Creek, and Crestview were constructed or enlarged.

Plans were being developed and/or property being acquired for new maintenance stations or additions at South Sacramento, Eureka, Redding, Mott, Lake Valley, Elk Grove, Redwood City, Napa, Santa Maria, Bakersfield, Tarzana, Newhall, Yucca Valley, Mountain Pass, Riverside, Crestview, Tracy, Lodi, Chula Vista and San Diego.

DESIGN

To keep abreast of steadily increasing usage of the state highway system, the Design Department of the Division of Highways is continuously engaged in the development of new methods and standards. As a means toward evaluation of current practices, completed jobs are inspected and operational reports are prepared for each new section of highway opened to traffic. These reports cover field review of every detail of highway design and the success of each feature under actual operating condition. Such items as drainage features, roadway delineation and aesthetics are checked and overall traffic operation is noted.

A second source of information is the reports of studies made through the Bureau of Public Roads, the Highway Research Board, the American Association of State Highway Officials, the Western Association of State Highway Officials and other allied technical or commercial sources. These reports cover all phases of highway operation. Notably there were the AASHO Road Tests. A current study includes the use of atomic power for roadway excavating.

New information relative to driver behavior and design practices is analyzed and where improvement can be accomplished, new instructions are issued. During the 1962-63 fiscal year 18 such instructions were issued relating to design features.

Another responsibility of the Design Department is the co-ordination of design activities with the Bureau of Public Roads in regard to development of the federal-aid systems. Close liaison with bureau officials is maintained in obtaining clearance of federal-aid projects and to facilitate review of any unusual situations which would require deviation from standard practice.

Geometric Design and Plan Preparation

Each interchange location or design situation presents individual circumstances, usually with some unique features. This requires constant attention to detail and consideration of areas where standards can be improved. Notable among the past year's developments are the following improvements:

a. New standards for freeway entrances and exits were developed.

b. Sight distance requirements were revised as a result of the lower profile of recent passenger automobiles.

c. The development of improved standards for providing more efficient traffic service at major freeway-to-freeway interchanges is under investigation.

d. A study is underway aimed at increasing the basic width of medians on divided highways.

During the year, 593 interchange or intersection locations were submitted by the districts and cleared by the Geometric Design Unit. There were 171 freeway agreements examined to insure that the final geometric design patterns could be developed in conformance with accepted practice. In addition, 57 requests for new freeway connections were processed and the necessary data prepared for presentation to the California Highway Commission. Twenty-six locations for bus stops, truck weighing facilities or safety rest areas were considered, and the geometric designs for these have been completed.

In the 1962-63 fiscal year, plans for 360 projects including 6,400 sheets of plans were processed through the Contract Plan Unit of the Design Department. Standardization of plans and conformance to established planning and design concepts are the responsibility of this unit.

Structural Design of the Roadbed

The Structural Design Unit is concerned with all the structural aspects of the roadbed, including thickness of base and surfacing and the selection of the most economical pavement type. During the past fiscal year a revised procedure was developed and has now been adopted for the economic comparison of alternate types of pavement for each project. This procedure underlines a growing trend toward greater emphasis on the use of economics and documentation in the selection of alternate materials.

Approximately 200 structural sections were investigated during the year, covering such features as documentation of pavement type, availability and quality of materials, side slopes, drainage and foundation treatments.

Frequently field observations are made to determine the effectiveness of current design. Features of portland cement concrete pavements studied included the performance of various joint spacings, extension of treated base layers beyond edges of pavement and the correction of faulted slabs by grinding methods. Another current study concerns the properties of thick asphalt concrete designs which have been used at selected locations throughout the State.

Drainage and Co-operative Agreements

Each project is investigated as plans near completion to insure proper drainage, and new techniques for improving drainage practices are constantly sought.

For example, in co-operation with the Materials and Research Department, the use of aluminum culverts is being investigated.

Also, in co-operation with the Bridge Department, new tables for computing the allowable height of fill over corrugated steel culverts based on the ring compression theory are being prepared coupled with changes in bedding and backfill requirements relative to height of fill and size of culverts.

The construction of freeways and the rapid growth which the urban areas are experiencing necessitates constant drainage improvements which benefit both the State and local developments. These improvements are performed under co-operative agreements. Highway funds are used for area improvements in proportion to the benefits accruing to the highway facility.

Special Studies

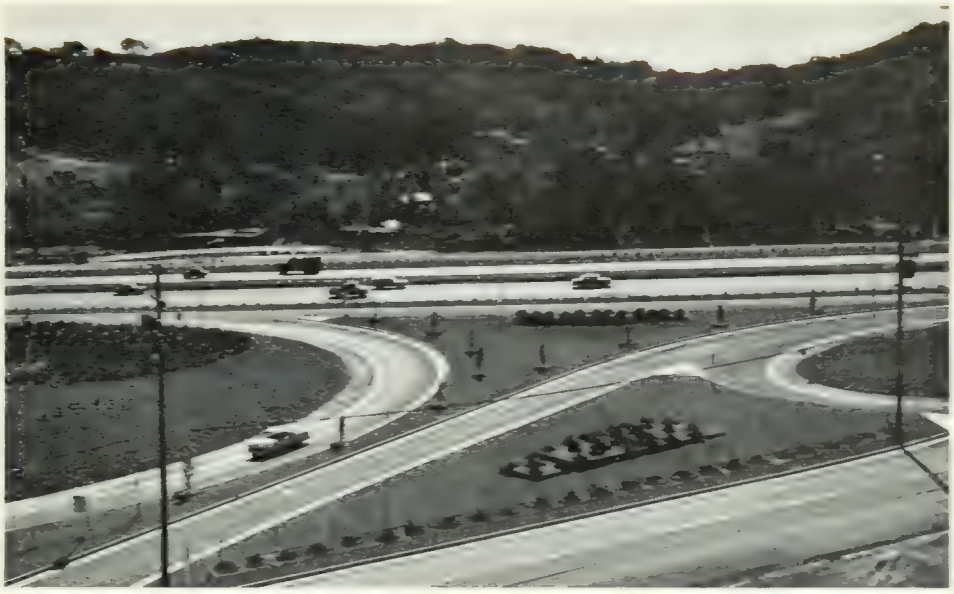
During the past year encouraging results have been obtained by the critical path method of programing design activities. In the field of data processing, a new program has been developed for plotting cross-sections using electronic equipment. This process is in the developmental stage; however, the program is expected to provide a useful service.

Another function of the Special Studies Unit is to keep close liaison among the various districts. As new techniques are developed they are introduced into all the districts as quickly as possible. One such process which has received considerable favor throughout the State is the use of the dropout reproduction process.

Highway Aesthetics

Highway aesthetics have always been considered in the development of plans for California's highways. This is evidenced by the flattened and rounded cut slopes and the aesthetic consideration in structure design. The recent expressions by the legislators through the investigation aimed at a scenic highway system for California, a roadside rest system and the consideration of special recreational and scenic elements to be incorporated into the design of the Westside Freeway have placed a renewed emphasis on the amenities in highway design.

The Design Department is meeting this emphasis by the addition of



The Lafayette Bypass landscaping showing paved traffic islands with shrubs massed in geometric patterns. This treatment provides adequate sight distance for the motorist and at the same time minimizes maintenance costs.

such features as contour-graded interchanges and increased attention to the impact of drainage and other structures on the highways' appearance. This aspect of highway design receives diligent consideration throughout the design processes.

Roadside Development

The Roadside Development Unit is concerned with the contour of the roadside and the type of planting for erosion control or related measures which contribute to a pleasing and natural roadside appearance. Planting must be consistent with public safety and properly designed for ease of maintenance. This unit is headed by a landscape architect.

Thirty-seven planting projects were processed during the fiscal year.

To take advantage of price benefits realized by performing certain preparatory landscape work under major construction contracts, all typical cross-sections for highway projects are studied by the Roadside Development Unit. Preparatory landscape items include such work as temporary erosion control, contour grading, deep cultivation, topsoil, paving island points and other areas too confined for planting, and placing water lines and conduits under roadways for future irrigation systems. This unit also assists in preparing the specifications for all erosion control work to be performed under construction contracts.

Most of the plant material is furnished by the contractors from commercial sources. A major portion of the state-furnished trees and shrubs also are purchased by the State from commercial nurseries. In many cases a contract to propagate and grow such plants is entered into between the State and a commercial grower. When the plants have reached the proper size they are delivered to the state nursery near Davis or to the holding yard in Los Angeles, where they are picked up by the various contractors.

Some plants not generally popular for garden use and therefore not grown by commercial nurseries but which have proved adaptable for roadside use are propagated at the state nursery. Also many freeway planting projects require larger quantities of certain plants than commercial nurseries are willing to grow without definite commitments. These, along with plants for experimental purposes also can be better furnished by the State.

Representatives of the landscape units continue to meet with beautification or improvement committees of

various communities in order to promote mutual understanding and acceptance of the overall roadside development program.

During the fiscal year, 31 contracts for landscaping, functional planting and tree planting were financed at an approximate total cost of $4,111,252. These projects involved the planting of approximately 184,350 assorted trees and shrubs and 5,648,000 ground cover plants and cuttings.

TRAFFIC

Motor vehicle travel on the state highway system in 1962 was approximately 36.4 billion vehicle-miles, an increase of approximately 5 percent over 1961. This represents approximately 47 percent of the total motor vehicle travel in the State.

Nearly half of the travel on the state highway system was in the cities. Freeways totaling only 1,152 miles of highways accounted for 14.4 billion vehicle-miles, or 40 percent of the travel on the 14,168-mile constructed state highway system and 18.5 percent of the total motor vehicle travel throughout the State.

Average accident rates on the state highway system in 1962 were as follows:

	Total accidents per million vehicle-miles	*Fatal accidents per 100 million vehicle-miles*
Urban conventional	5.26	3.71
Rural conventional	2.53	9.10
Urban freeways	1.55	2.63
Rural freeways	1.22	4.88

Before January 1963, only those accidents occurring on the rural state highway system and on rural and urban freeways were coded and key punched for electronic data processing. Starting with 1963, all accidents on all state highways are being coded, regardless of rural or urban area or access control classification. This has doubled the number of reports being coded, from approximately 56,000 in 1962, to a projected 110,000 or more in 1963. At the same time, the information being coded and the coding procedures have been revised to improve efficiency and to tabulate more meaningful and useful data.

Research on Safety and Traffic Operation

Some highway safety research projects currently underway are:

1. Evaluation of minor improvements and development of criteria to predetermine their probable effectiveness at other problem locations.
2. Ways of preventing wrong-way driving on freeways and their connections.
3. Comparison of similar freeway sections to determine reasons for dissimilar safety records.
4. Before and after evaluation of median barriers.
5. Relation of ramp types to accident rates.
6. Multiple-vehicle accidents in fog.

The safety evaluation of minor improvements is a continuing study. An interim evaluation in 1962 indicated that minor improvement projects have been successful in reducing accidents at many problem locations. Those projects studied to date have averaged a 32 percent reduction in the number of accidents, notwithstanding increased traffic volumes.

Phase 1 of the study of wrong-way driving on freeways has been completed—the analysis of wrong-way incidents reported by the California Highway Patrol for a nine-month period in 1962. The study indicates that the wrong-way driving problem is greater than originally believed. Since 60 percent of the wrong-way drivers on freeways were found to have entered at offramps, special emphasis is being placed in the second phase of the study on measures to prevent this infraction. Pavement arrows have been painted at the offramp terminals, and several problem locations have been further improved by signing and channelization. Special signs are being tested at the University of California Los Angeles driving simulation laboratory and special devices such as retractable directional barriers will be tested.

Research continued on several phases of freeway operation to develop relationships between traffic operation and geometric design. Studies in progress include the evaluation of the effects of trucks on highway capacity being conducted by the Institute of Transportation and Traffic Engineering in co-operation with the U.S. Bureau of Public Roads. The Traffic Department has issued a report (Traffic Bulletin No. 4) summarizing freeway capacity studies to date and discussing the various aspects of capacity related to design.

A special research study was made of delay to traffic due to lane closures



An experimental illuminated sign with a changing message to warn fast traffic of a stop or slow moving traffic ahead at the signalized intersection of U.S. 50 and Sign Route 33 near Tracy.

during construction. This study involves the observation of traffic backups on various freeways, mostly in metropolitan areas, when a lane is taken out of service due to widening, repairs to structures, or resurfacing of the freeway itself.

Traffic Counting

The mechanized traffic census program adopted in 1961, while yielding much more data on all traffic, produces no vehicle classification information. In June 1963, a new manual truck classified count was initiated to update the previous 1960 truck data. Although less extensive than the 1960 and prior manual counts, it will suffice to establish new truck data in each axle classification on all state routes. Information from the 1963 counts will establish truck patterns in the two-axle, three-axle, and four-or-more axle classification.

Research and testing are being continued on various types of traffic detectors for traffic counting. A mechanical truck counter is also being developed by the Materials and Research Department which will classify vehicles automatically by number of axles. If successful, it will replace manual classification counting. A prototype of the counter was constructed by and is in use in one district.

Traffic Signals and Illumination

Contract plans were completed for 137 new traffic signals and modernization of 136 existing signals. Contract plans were also completed for 4,718 lighting standards and 392 illuminated traffic guide signs. The total estimated cost of the electrical work was $7,374,741, not including the cost of steel sign structures.

A total of 169 traffic reports reviewing conditions at approximately 416 intersections were made to determine the need for traffic signals and lighting.

Research projects completed include the following:

1. Research by a private firm to develop a nuclear-energized self-luminous highway directional sign.

2. Development and installation of fluorescent lighting fixtures in the pavement for illuminating the underside of trucks at truck weigh station inspection areas.

3. Development of a rotating-type changeable message sign for use at truck weigh stations and for lane control.

An installation of a new expressway-type traffic signal was completed at the junction of U.S. 50 and State Sign Route 33 (Bird Road) near Tracy. A large overhead changeable message sign placed in advance of the signal reads "PREPARE TO STOP" when the motorist will be required to stop, even though he may see the signal ahead is still green. This gives the motorist advance notice of a coming change in the signal. Immediately after the signal turns green again for the expressway, the sign changes to "SLOW TRAFFIC AHEAD" to warn approaching motorists that traffc at the signal is just beginning to accelerate.

This installation has been effective in preventing accidents.

Traffic Regulation and Control

During the fiscal year, studies were made in connection with the proposal for renumbering the state highway system to eliminate the long-standing multiplicity of various route designations for legal, administrative and traffic purposes. Senate Bill No. 64 providing for renumbering of the state highway system was signed into law by Governor Edmund G. Brown on May 14, 1963. Changes and elimination of some U.S. route numbers were recommended to the American Association of State Highway Officials and approved by that body in June.

Upon completion of the inventory of existing highway signing which began last year, a schedule was established for systematic revisions of state highway signing to comply with the 1961 National Uniform Manual for Traffic Control Devices. This is required by the Bureau of Public Roads for all federal-aid highways.

Traffic control measures taken during the year included:

1. 138 restricted speed zones were established and 37 speed limit orders were rescinded, resulting in 117 additional miles of speed restrictions on state highways.

2. 67,642 signs were approved for installation, comprised of 25,738 warning signs, 14,750 regulatory signs, 14,444 guide signs and 12,710 miscellaneous and construction signs.

A continuing function is the review and processing of traffic regulations initiated by cities, counties, and the districts involving parking, turning movements, and one-way operation of streets in the state highway system.

URBAN PLANNING

The Urban Planning Section was formed on July 1, 1962, as part of the division's growing concern in urban transportation planning. Its first project was the preparation of the "Prospectus for a San Francisco Bay Area Transportation Study" in conformity with Senate Concurrent Resolution No. 20 (1962). This was submitted to the Legislature on October 30, 1962.

Highway Planning Survey, charged with statewide and special planning studies, was combined with Urban Planning on November 1, 1962. The consolidation of the two sections increased the resources available for urban transportation planning without lessening consideration of rural highway planning.

Four general units comprise the new department: Urban Transportation, Highway Inventories and Legislative Reports, Research and Special Studies, and Electronic Data Processing. The Planning Library, which serves the entire Division of Highways and the director's office, also is included.

The 11th Annual Western Association of State Highway Officials Planning Conference was sponsored by California in San Francisco in July 1962. It was attended by highway planning officials from the western states and by representatives of the Bureau of Public Roads.

Urban Planning Studies

The Federal-Aid Highway Act of 1962 demands that a continuing comprehensive urban transportation planning process be underway in California's 11 urbanized areas by July 1965. Results are now being analyzed and procedures to meet the requirements are being formulated.

State highway planning, financed by the Bureau of Public Roads, and the local planning financed by the U.S. Housing and Home Finance Agency have been co-ordinated through a close working relationship with the State Office of Planning, which administers HHFA grants, and the federal representatives of the HHFA and BPR.

A two-day conference on urban transportation planning for local, state and federal officials responsible for planning and engineering, was held in Sacramento in February 1963.



Looking west at the recently completed Crosstown Freeway in San Diego from above Balboa Park.

Metropolitan Transportation Studies

Major efforts were devoted to work on the Los Angeles Regional Transportation Study (LARTS). Progress for this long-term study has included improvements in methodology and computer programming and the completion of the processing for an initial development and assignment of traffic to a 1960 system of streets and highways. The assigned traffic data included the results from a 1960 truck survey, a 1960 external cordon survey, and simulated trips for all internal residents of the study area. The combined trips for an average weekday totaled 14.1 million and represented 84.5 million vehicle miles.

Processing of network data for obtaining trips, developing routes and obtaining traffic volumes required an average of about 200 hours of computer processing per month throughout most of the year. These extensive calculations included the processing for the calibration of the 1960 traffic simulation model, the final 1960 trip simulation and assignment, and, the development of a 1980 street and highway network.

In co-operation with the Bureau of Public Roads and District I (Eureka), the transportation phase of the Eureka Area Planning and Transportation Study has been undertaken at the request of the City of Eureka and Humboldt County.

Statistical and Nonmetropolitan Studies

Field operations were begun in June 1963 for the loadometer (truck weight) study which is conducted each year in co-operation with the BPR. The survey was expanded this year to collect additional information necessary for the development for axle weight trends, trip characteristics, and vehicle classification information. Trip characteristics involve type and location of terminal, trip length, and commodity carried. These data are useful in estimating intercity ton-miles and for comparisons of ton-miles between highways and other modes of transportation.

The data handling and statistical reporting unit took part in the continuing studies of pavement life, interstate traveled way, and other studies reported to the BPR. It also has taken part in special studies, such as a pavement evaluation study for the BPR and outdoor advertising legislation for the State Legislature.

The status of highways and the federal-aid log were changed to accommodate the renumbering and revision of the federal-aid systems and, at the same time, the federal-aid logs were improved.

Highway Inventories and Legislative Reports

Updating the state highway inventory was continued on a statewide basis. Capacity adequacy ratings for

all projects were recomputed as new data became available from project reports, planning studies, and final reports.

Legislative studies completed included:

Senate Concurrent Resolution No. 4 (1962) which recommended that the Legislature designate nearly 5,000 miles of California roads as "state scenic highways." This report was submitted to the Legislature in March 1963. The Department of Public Works co-ordinated the study in collaboration with the Departments of Conservation, Parks and Recreation, Water Resources, and the State Office of Planning. The scenic highway system was described in the March-April 1963 issue of *California Highways and Public Works*.

S.C.R. 6 (1962) was a study of feasibility of a Humboldt Bay crossing. This study gave cost estimates for various bridge crossing proposals.

S.R. 26 (1962), concerning the development of recreational areas along rivers where crossed by bridges, made recommendations in regard to the provision of recreational facilities.

As the result of a request from the Senate Fact Finding Committee on Transportation and Public Utilities, a master plan and estimate for a system of roadside rests (safety rests) in California was completed.

In November 1962 a final report was submitted to the Legislature on the feasibility of renumbering the state highway system, as requested by the Legislature through S.C.R. 8 (1962). Following passage of Senate Bill 64, which requires renumbering the state highway system, work was continued on the many far-reaching changes in mapping, in administrative recordkeeping, and sign installations. The provisions of S.B. 64 become operative on July 1, 1964. It will eliminate the long-standing multiplicity of various route designations for legal, administrative, and traffic purposes.

Necessary preliminary work was started for several periodic studies for the Legislature, such as the State Highway Needs Study, the City Street and County Road Deficiency Study, and the review of the California freeway and expressway system and the state highway system.

Monthly reports on the status of completion and development of the interstate system and the California freeway and expressway system have been initiated.

Research and Special Studies

Co-ordination of research financed under federal-aid 1½ percent planning and research funds was continued. These activities involve not only division personnel, but also contracts with universities and private consultants. In conjunction with the BPR, new procedures to attain better control and information on research under way were adopted.

Special studies for the BPR covered the use of certain lanes exclusively for mass transit (buses), and an analysis of cost and other effects of resurfacing with various thicknesses of asphaltic concrete.

Interstate system studies are continuing. Various highway features have been reviewed with respect to their accident incidence and traffic characteristics in order to aid in refining geometric design standards. Another study was the listing of recreation areas adjacent to interstate routes.

Electronic Data Processing

The Data Processing Unit is a balanced processing center with EAM (electronic accounting machines) and EDP (electronic data processing) equipment, as well as some data transmission facilities to the Los Angeles area. Nearly all of the data processing for Headquarters Office and district offices are handled by this unit.

A wide variety of data was processed throughout the year, including engineering computations, accounting, LARTS origin and destination studies, freeway studies, traffic data, personnel records, bridge design computations, accident data, statistical data, and Division of Architecture accounting. During the past year the engineering computations, accounting, and traffic studies (including LARTS) were the major users of the equipment; these three areas accounted for 80 percent of the available production time of the computers.

In comparison with the previous fiscal year, engineering computations decreased 18 percent in volume, accounting increased 311 percent, and traffic studies increased 44 percent. Part of the decrease in engineering computation time reflects completion of reprograming IBM 650 work to the IBM 704 unit. The large increase in accounting reflects assignment of the IBM 1401 unit acquired the previous year to almost full-time accounting work in order to reduce backlog.

Through co-operative effort with the Fiscal Management Department and the districts, reporting of monthly accounting transactions through the EDP system was greatly improved over the previous year.

A team of consultants spent the last eight months of the fiscal year studying the division's operations. Particular emphasis was placed on the accounting and data processing work with a view to streamlining the operations and organization. At the same time new areas of applications for data processing techniques and equipment were investigated and reports submitted by July 1, 1963. The study has resulted in a decision to place key punch equipment in the district offices for the input of accounting data. Additional results of the study may be expected in the year ahead.

Bridges

The Bridge Department is under the administration of the Assistant State Highway Engineer—Bridges and is responsible for the design, construction and maintenance of all bridges and structures on the state highway system

A branch office of the Bridge Department is located in Los Angeles to maintain liaison with southern area districts, perform planning functions and supervise construction and maintenance of structures within these districts. All other functions, including design work, are handled at headquarters in Sacramento.

The department is divided into five sections—Planning, Operations, Special Studies, Office Engineering, and Special Projects. The maintenance and operation of state-owned toll bridges have also been under the administration of the Bridge Department (until November 18, 1963; see page 57).

BRIDGE PLANNING

Advance Planning

The Advance Planning Section's work of bridge site investigations, preparing preliminary design reports, reviewing project reports and collecting and assembling data for design continued at the same intensified pace as during the last fiscal year. Engineering design was initiated on 566 structures, one less than during the 1961-62 fiscal year.

Close co-ordination with the districts was maintained in all phases of highway design. Special consideration was given to Interstate Route 280 in Santa Clara and San Mateo Counties. A consulting architect was employed to advise on the design of the structures on this route which traverses the east side of the coast range, lying adjacent to the Crystal Springs Reservoir and passing through Woodside, Hillsborough and the Stanford University Campus.

Special attention was devoted to the structures along proposed routes through Beverly Hills and along U.S. 101 Alternate Freeway in Orange County.

Also, the new freeway through Sacramento, that is Interstate 5 along the Sacramento River, Interstate 80 through the 29th-30th Street and W-X Street corridors and have been studied extensively so that architecturally pleasing as well as functional structures will be provided for the traveling public and the community.

During the 1962-63 fiscal year studies were continued for metropolitan freeways for single- and double-decked viaducts, multilevel interchanges, tunnels, long-span structures and a large variety of highway separations.

Bridge Architectural Design

With more and more emphasis being placed on aesthetics in bridge design there was a definite increase in the workload of the Bridge Architectural Design Section during the fiscal year. Some district personnel were trained in photo retouch techniques.

Some 130 architectural design renderings, sketches and photo retouches were prepared; the results of which will ultimately be seen in new column and superstructure shapes, textured walls and architecturally treated slope paving. Models were constructed for design purposes for four major interchanges. One noteworthy model was made covering the whole of Emerald Bay. Both proposed upper and lower routes were shown for comparison on the same model.

Foundation Section

This past fiscal year the foundation section added a seismic unit to the exploration equipment for making subsurface investigations. With this unit it is possible to make studies more



The bridge across the South Fork Eel River at Myers Flat, Humboldt County, was awarded the American Institute of Steel Construction's first prize as most beautiful bridge of its class (fixed spans under 400 feet) opened to traffic in 1962.

rapidly in areas where access problems are difficult for conventional drilling equipment. Less time required for foundation studies results in lower costs for this phase of bridge planning.

A computer program which has been set up for the reduction of field notes makes it possible to have the results of a seismic field survey the following day, thus reducing the time required for office work.

The section is continuing its pile load test and fill settlement program. Feasibility investigations for the installation of large piles up to six feet in diameter are also being made.

This past year the section made studies for more than 500 structures and numerous retaining walls.

Obsolete equipment used for foundation exploration work has been replaced with modern units, resulting in greater operating efficiency.

Design

Although the total plan output was comparable to recent past years, the "glamorous" jobs which are usually mentioned in detail are missing from this year's production.

The most notable accomplishment was the completion of the structures on the Westside Freeway (Interstate 5) from the southern terminus at U.S. 99 in Kern County to the San Joaquin county line. There are 123 structures on this 222-mile section of the freeway which have a total estimated cost of $12,900,000.

An interesting phenomenon of the area traversed by the Westside Freeway is a peculiar type of subsidence which has influenced the design of the highway and the structures. Portions of the highway traverse alluvial fans which have never been consolidated because of the extremely low rainfall prevailing on the west side of the San Joaquin Valley. This area may come under irrigation as the California Water Project extends canals into the area and an unusual shallow subsidence is expected to occur. The bridges in this area are articulated so that they can be adjusted to compensate for subsidence of the bridges or the highway.



One of the structures pioneering use of high-strength steel is the Whiskey Creek Bridge where rerouted U.S. 299 crosses the Whiskeytown Dam reservoir.

A new trend during the past year was the more extensive use of alternative designs. In cases where preliminary estimates show two or more types of structures to be nearly the same cost, alternative designs were prepared and the contractor was given the option of selecting the type of structure he wished to build. Typical of the alternative designs which went to contract were the Hot Springs Creek Bridge on the Monterey Coast which permitted either reinforced concrete or prestressed concrete construction and the bridge across the North Yuba River near Downieville which featured both steel girder and prestressed concrete girder alternatives.

Bridge Construction Costs

Bridge construction costs, as measured by the department's cost index began the year with an index value of 288 which fluctuated during the succeeding quarters from 274, 264, 290 and 264. Bridge construction costs during the 1962-1963 fiscal year were virtually the same as the preceding fiscal year.

BRIDGE OPERATIONS

Sixty-one structures in 45 Bridge Department administered contracts were completed during the year at a total dollar value of $35,620,000. This included the San Pedro-Terminal Island suspension bridge substructure ($2,800,000), the Benicia-Martinez Superstructure ($8,900,000), and the Webster Street Tube ($16,500,000).

There were 445 structures in 97 district-administered contracts, these structures having a value of $71,293,000. Also, there were a number of retaining walls constructed, and widening and repair of existing structures. There were 162 structure projects, with an approximate cost of $163,600,000, underway at the end of the fiscal year. These included the San Pedro Terminal Island suspension bridge superstructure (Vincent Thomas Bridge) contract, projects financed from various fiscal year budgets, and work on federal-aid secondary projects.

The 1962-63 state highway budget had $85,302,000 in structure work in

109 projects. Miscellaneous projects, including maintenance, FAS, and work for other agencies, amounted to $2,736,000 structure work in 21 projects. The grand total of all structures in this budget year that were advertised and placed under contract in 130 projects was $88,038,000.

Metropolitan Area Freeway Structures

In Oakland, one more section of the MacArthur Freeway (Interstate 580), including six major structures, was opened to traffic. The freeway is now open as far as Park Boulevard. Three more sections of freeway are under construction. The first section, from Park Boulevard to Buell Street, including structures at 12 locations, is nearing completion. The next two contracts, which extend the freeway into San Leandro, include structures at 21 locations, costing approximately $5,000,000.

Widening of Nimitz Freeway to eight lanes as far as Hegenberger Road, which included widening of three major structures costing over $2,500,000, was completed.

The $17,000,000 Webster Street Tube, which connects Oakland and Alameda, was opened to traffic February 13, 1963. This facility, which provides two more lanes of traffic, was under construction for more than three years. The tube is made up of 12 precast sections, 37 feet in diameter and 200 feet long, plus a 783 foot cast-in-place section. This was the 12th tube built by this method, the adjacent Posey Tube being the first.

The Posey Tube, now being remodeled under a $1,100,000 contract, will be reopened sometime in December 1963.

On the Santa Monica Freeway Viaduct in the Los Angeles area, three major contracts totaling 8.24 miles of structures were under construction during the year. This is an increase of nearly four miles of viaduct carrying eight lanes of traffic from the heart of the industrial section of Los Angeles toward Santa Monica.

On the Golden State Freeway, 13 structures were completed and 22 others were under construction.

Progress on the San Diego Freeway was highlighted by the opening of nearly 10 miles of continuous freeway. This section of the new freeway, which extended from Burbank Boulevard in the City of Burbank to Rinaldi Street in San Fernando, included three contracts involving 30 structures.

In the San Bernardino-Riverside area, 47 structures were completed and 43 structures were under construction. Thirty structures were completed in the San Diego area and 52 structures are under construction.

In addition to the Benicia-Martinez Bridge over the Carquinez Straits, located just 200 feet west of the existing Southern Pacific railroad bridge, there were major structures completed on Interstate 680 at eight locations in Solano County and 11 in Contra Costa County.

In Contra Costa County there were 2 major freeway projects under contract having large amounts of structure work. In Concord, on Sign Routes 21 and 24, nine structures were under construction at a cost of $2,000,000. South of Walnut Creek, on Route 21, there were 13 bridges and interchanges being built under a $13,750,000 freeway contract.

In Alameda County, two major railroad undercrossings were completed at Jackson Street and Orchard Street in Hayward.

In the San Francisco West Bay area, construction is in progress on the Southern Freeway from Orizaba Avenue across the James Lick Memorial (Bayshore) Freeway to Newcomb Avenue. This section includes 27 bridge structures and a half-mile section of double-deck viaduct extending northeast from the Alemany intersection of the Bayshore Freeway. The half-mile viaduct section, which is a portion of the planned 4½-mile section that will extend to the Embarcadero Freeway, will have a construction cost of about $3,000,000.

Other Major Projects

Work continued on the new bridge and fill crossing of the Yolo By-pass. The structure was opened to traffic on September 14, 1962, with two-way traffic using the eastern structure.

Work started on the substructure of the new Sacramento River Bridge at W-X Streets in Sacramento. This substructure work consists of constructing three river piers. The bridge is to be a nonmovable type with a minimum vertical clearance of 55 feet. It is estimated that the contract will be completed in June, 1964. Work on the superstructure contract is scheduled to begin early in 1964.

The steel arch bridge across Cold Spring Canyon on Route 80 in Santa Barbara County continued to take shape. The steel arch ribs were erected with connection being made June 27, 1963.

Tunneling operations continued on the 3,300-foot-long Caldecott Tunnel through the Berkeley Hills. Seven percent of the concrete tunnel lining had been placed at the end of the fiscal year. Successive stages of work on this project will continue throughout the coming year, with completion anticipated in late 1964. The total estimated cost is $11,000,000.

The Randolph Collier Tunnel, located in the extreme northwestern portion of California on U.S. Highway 199, was dedicated and opened to traffic on July 20, 1963. The tunnel is 1,836 feet in length, entirely concrete lined, and provides two 13-foot traffic lanes and safety walks on each side.

Construction of the tunnel, started in January, 1961, cost approximately $4,300,000.

County and City Bridges

During the year the City and County Bridge Projects Engineer reviewed plans for bridges and minor structures in 59 projects financed from gas tax apportionments to the cities.

In addition, 15 bridges with a total contract cost of $600,000 were included in eight FAS contracts. The county engineering departments prepared plans for 14 of the structures and provided the construction engineering for 13.

The floods of October 1962 and February 1963 caused heavy damage to bridges in some counties. At county request the department evaluated the amount of storm damage on 27 structures. Proposed plans for repairs or replacement were reviewed as submitted by the counties.

Bridge Maintenance

Periodic field investigations were made of the 7,398 bridges on the state

highway system. Capacity ratings for all structures were reviewed and kept up to date and the replacement of structurally critical bridges was scheduled.

On January 31, 1963, the westerly two spans and intermediate pier of the North Yuba River Bridge on State Sign Route 49 in Sierra County were carried away by flood. A single 120-foot welded plate girder span was designed, constructed and was carrying traffic 13 days later to replace the pony trusses.

On February 1, 1963, two bents of the Spanish Creek Bridge on U.S. 40 Alternate near Quincy were undermined by scour and settled, closing the bridge to traffic. Repair work, under emergency contract, consisted of driving steel H-piles through holes cut in the concrete deck, supporting the settled bents in place and constructing a temporary supplementary superstructure. This bridge was opened to one-way traffic in 12 days.

Critical Problem

A critical problem developed on the bridges across New River near Seeley on U.S. Route 80. The continued deep-seated movement of the large mass of earth at the west end of the bridge made it necessary to undertake emergency repairs to maintain a safe traveled way. Even though the structures had been designed to accommodate movement of the substructure, with respect to the superstructure, the actual movement of about 5 feet required numerous repairs. The structures are being replaced with a quadruple 10x8-foot box culvert and fill.

Hyde Street Pier

At the request of the Division of Beaches and Parks plans were prepared for renovating and improving a pier at Hyde Street in the San Francisco Maritime State Historical Monument. The contract for this work was handled by the Bridge Department, at a cost of approximately $400,000.



Construction work on the Cold Spring Canyon Bridge on Sign Route 150 between Santa Barbara and Santa Ynez. It is listed among the 10 longest steel arch bridges in the United States.

The Bridge Maintenance Section made engineering investigations at the request of local authorities for 69 city and county bridges to establish their load-carrying capacity. Eight public hearings were held, as a result of which 20 of these bridges were posted for less than legal loads.

Bridge Maintenance Painting

Four maintenance painting contracts involving repainting four structural steel bridges and railings on six bridges were initiated by the Bridge Department during the past fiscal year. The small number which required repainting indicates the extent of progress made in prolonging the paint service life on our steel bridges during the last decade.

Inspections Made

Bridge painting inspectors made inspections on more than 500 steel structures during the past year. They were also assigned as resident inspectors on all maintenance painting contracts as well as assisting on various phases of new construction work.

Experimental work with recently developed materials and methods continues, its aim being to further increase the protective service life of paint coatings on steel structures.

SPECIAL STUDIES

The scope of structural research work continues to expand. The total number of active projects has about doubled in the past year. In final stages of data reduction and report preparation are projects on concrete box girder characteristics; concrete bridge deck cracking; epoxy adhesive and sealant performance; seismic forces on long piles; and bridge barrier railing behavior under dynamic loads.

In middle stages of testing and data accumulation are projects on friction losses in prestressing steel; service life of bridge bearings; viaduct deck drain characteristics; orthotropic structural frame behavior; and arch culverts under high fills.

Preliminary Planning Underway

Preliminary planning and initial study are underway on new projects

concerning bridge deck insulation; reinforcing steel corrosion; bridge deck joints; and the effects of aerodynamic and seismic loads on a suspension bridge. Efforts in the electronic computer service area have emphasized development of a program to analyze concrete bridge substructure frames. A companion to a completed program for superstructure analysis, it will feature automatic load selection and application, flexibility to handle most frame sizes and configurations, minimum input data requirements, and comprehensive results.

Program Conversion

Other efforts resulted in completion of a program to construct structural influence lines, and continued progress in revision and effective conversion of old computer programs to current data processing equipment.

Analyses of specific site problems in the fields of hydrology, hydraulics and bank protection are being continued. Initial study is underway on a combined structural-hydraulics research project concerning the undermining of bridge foundations by hydraulic scour.

Special Studies

Special studies undertaken include participation in a co-operative study of concrete deck deterioration, evaluation of corrosion of reinforcement in structures located in marine environment, and measurement of airflow in the ventilation system of the Webster Street Tube.

Bridges on the State Highway System Segregated as to Number, Length and Area by Structure Type, as of June 30, 1963

Structure type	Number 1963	Number 1962	Length [a] (feet) 1963	Area [b] (square feet) 1963
Concrete arch	232	239	36,818	851,326
Concrete girder	2,158	1,892	491,294	31,648,940
Concrete slab	2,414	2,358	145,885	6,250,426
Masonry arch	33	33	962	21,735
Subtotal concrete and masonry	4,837	4,522	674,959	38,772,427
Steel arch	5	5	1,400	22,439
Steel plate girder	358	350	171,930	7,423,968
Steel stringer	277	282	60,504	3,479,474
Steel deck truss	30	29	33,166	1,550,439
Steel pony truss	29	30	10,524	168,548
Steel through truss	63	65	115,999	1,491,740
Suspension	2	2	15,097	884,145
CMP multiplate and arch	77	74	1,482	50,503
subtotal steel	841	837	410,102	15,071,256
Timber arch	1	2	59	780
Timber stringer	585	605	42,473	1,502,440
Timber deck truss	6	8	1,576	23,974
Timber pony truss	0	1	0	0
Timber through truss	1	1	79	1,722
subtotal timber	593	617	44,187	1,528,916
TOTAL BRIDGES	6,271	5,976	1,129,248 (214 miles)	55,372,599 (1,271 acres)
Underpasses	181	182		
Overheads *	266	242		
Combined bridge and overheads *	54	48		
State highway separations *	294	272		
Road undercrossing *	1,179	952		
Road overcrossings	813	725		
Pedestrian undercrossings *	176	157		
Pedestrian overcrossings	86	78		
Cattlepasses *	90	88		
Tunnels	21	20	17,549	
Retaining walls	6	6	4,707	
Miscellaneous	20	19	400	10,325
TOTAL STRUCTURES	7,398	7,006	1,151,904	55,382,924
Drainage pumping plants	193	185		
Railroad grade crossings	641	676		

* Separations so noted are listed under structure type above.
NOTE: One underpass, 19 overheads, 1 tunnel and 3 bridge and overheads also serve as state highway separations.
[a] Structures of assorted types and lengths of spans are by number and length of main span.
[b] Areas are based upon clear width of roadway between curbs and clear sidewalk width.

BRIDGE OFFICE ENGINEERING

Bridge office engineering includes the administration and management of the various service units.

A major function is the negotiation and preparation of maintenance and construction agreements with railroads in connection with construction of railroad grade crossings and grade separations.

Railroad Grade Crossings

Construction was started, underway or completed on 53 highway projects requiring negotiations with railroads which involved right-of-way encroachments, installation of additional crossing protection, construction, alteration or abandonment of grade crossings. At the end of the fiscal year, negotiations with the railroads were in progress for 23 additional highway projects on which construction had not yet started. In addition, 34 projects involving improvement of existing crossing protection were completed or underway.

On federal-aid secondary routes, negotiations were underway or completed on 14 projects with railroad involvement.

Railroad Grade Separation Structures

At the beginning of the year, 63 railroad-highway grade separation structures were under construction. A total of 43 railroad separation structures were placed under contract during the year of which 5 were underpass structures and 38 were overhead

structures. Three of these structures were completed during the year. During the year a total of 35 railroad separation structures was completed. The railroads are contributing an estimated $163,064 toward the cost of constructing 5 of the 35 completed structures and for removing Kerman Underpass.

$5 Million Grade-crossing Fund

The Public Utilities Commission issued the 1962 priority list containing 33 proposed separation projects to eliminate railroad grade crossings and reconstruct existing separation structures on county roads and city streets. In accordance with state law, $5,000,000 in state funds is set aside by the Highway Commission each year to pay half the cost of each separation project after deducting the railroad contribution.

As of June 30, 1963, allocations totaling $4,286,056.20 had been made by the Highway Commission from the 1962-63 fiscal year funds for 8 of the 33 projects on the PUC priority list.

Corps of Engineers and State Reclamation Board Permits

During the past year, permits have been received from the Corps of Engineers to construct twin bridges across the Sacramento River, a ferry slip, and install underwater cables.

Seven permits have been received from the State Reclamation Board for construction projects.

SPECIAL PROJECTS

On September 15, 1962, the Benicia-Martinez Bridge was opened to traffic. The completion of this structure provides another new highway facility across the Carquinez Strait completed and opened to traffic within the past four years. The Carquinez Strait has for many years been one of California's most difficult and costly barriers to highway transportation. The Benicia-Martinez Bridge adds four modern traffic lanes across this water barrier in addition to the seven at the Carquinez Bridge. This is estimated to provide adequately for the traffic needs across the Carquinez Strait until well into the 1980's.

The Benicia-Martinez Bridge and approaches required seven contracts with a total construction cost of about $23,203,300. The bridge proper was constructed in two contracts at a construction cost of about $14,302,500, which is considered very economical for this type of construction. The new type of foundation construction and the use of new high-strength steels contributed a great deal to the economy of this major deep-water bridge construction.

Traffic across the bridge since opening has been about as anticipated. Traffic figures to date indicate that for the first year of operation the average monthly count should be about 190,000 vehicles.

On April 25, 1963, Governor Brown signed Senate Bill 50 redefining the limits of the Benicia-Martinez Bridge, which extends the Solano County approach to the bridge from the toll plaza to Interstate Route 80 at Cordelia. Refinancing the Carquinez Strait Bridges Revenue Bonds (authorized by the California Toll Bridge Authority later in the year) makes it possible for unused funds to go toward construction of the Solano County approaches as set forth in the legislation.



The substructure contract for replacement of the Napa River Bridge at Vallejo was completed in April 1963. The new bridge will be a high-level fixed span to allow waterway navigation to pass underneath. Present span (right) has a bascule span which must be opened an average of a hundred times a month.

The Vincent Thomas Toll Bridge between San Pedro and Terminal Island was scheduled for opening to traffic on November 15, 1963. Completion of cable spinning and hanging of the 1,500-foot main suspended span were the primary achievements in the construction progress of this bridge. All contracts were completed during the fiscal year except for the last stages of work on the superstructure.

There were three major contracts and three smaller contracts involved in the construction of the bridge with its approaches and toll plaza. The total cost, including right-of-way and engineering costs, was $18,883,000.

This 6,000-foot structure with its four traffic lanes is Southern California's first suspension type highway bridge. It was dedicated as part of a community celebration on September 28, 1963.

STATE-OWNED TOLL BRIDGES

San Francisco-Oakland Bay Bridge

A record total of 42,058,144 vehicles crossed the San Francisco-Oakland Bay Bridge during the year. This is an increase of 3.8 percent over the preceding year. The daily average for the year was 115,228 vehicles.

The month of highest average daily traffic was June 1963, with a new record high of 123,297 vehicles per day. The previous high was in June 1962, when the daily average was 115,709 vehicles. New high figures for a single day's traffic were established in two successive months during the fiscal year—first on May 24, 1963, with 133,772 vehicles, and again on June 28, 1963, with 143,456 vehicles. Both these records were on Fridays, and it is interesting to note that every record high day in the history of the bridge has been a Friday. The highest record for the preceding year was 133,604 vehicles on September 1, 1961.

The revenue derived from vehicular tolls, rent, and miscellaneous services, exclusive of interest, was $12,858,464, an increase of $511,660 over the preceding year.

The contract for remodeling the westbound toll plaza was completed in May 1963. The rebuilt and enlarged plaza provides 17 toll lanes to accommodate all westbound traffic after conversion of the bridge to one-way traffic on each deck. The final contract for the lower deck traveler system was completed, providing rail-mounted travelers for maintenance of the entire length of the lower deck floor systems. A similar system of travelers for the upper deck floor systems was completed in 1953.

The painting of the structural steel in the Transit Terminal loop was 95 percent complete at the end of the fiscal year. Because the work was principally over heavily traveled streets and parking lots in downtown San Francisco, steam cleaning, sandblasting and painting was done on Saturdays and Sundays.

The Division of San Francisco Bay Toll Crossings continued work on the $35,000,000 remodeling of the Bay Bridge. At the end of the fiscal year, all necessary contracts had been completed except that of resurfacing the upper deck for conversion of the bridge to five lanes of one-way traffic on each deck.

Richmond-San Rafael Bridge

Total traffic on the Richmond-San Rafael Bridge amounted to 4,000,250 vehicles, an increase of 7 percent over the previous year. Correspondingly, revenue amounted to $3,332,578, an increase of 6.6 percent.

A bridge tow service was inaugurated on January 1, 1963, to reduce toll lane congestion on account of stalled vehicles and to provide better service and reduce hazard to the motoring public.

Two contracts were let: one to install two additional air compressors on the structure to provide an adequate air supply for bridge maintenance operations, and the other to expand and improve facilities at the Administration Building.

Safety devices were installed on the outside bridge ladders. These devices are so designed that a workman wearing a safety belt can move up or down the ladder in a normal manner, but any sudden movement downward or toward the ladder causes a pawl attached to the safety belt to engage notches in a vertical safety rail and arrest the man's fall.

San Mateo-Hayward and Dumbarton Bridges

The total traffic on the San Mateo-Hayward Bridge for the year was 4,285,404 vehicles, and the corresponding toll revenue amounted to $1,655,800. For the same period, the traffic on Dumbarton Bridge was 3,352,777 vehicles, with a corresponding toll revenue of $1,243,618. These traffic figures, compared to those of the previous year, indicate an increase in traffic of 6.7 percent and 13.5 percent respectively, over the preceding year.

A fifth toll lane was added at the Dumbarton plaza during the year, to accommodate the rapidly increasing volume of traffic. Planning is underway to provide an administration building and an improved canopy structure at this toll plaza.

The deck of the Dumbarton Bridge was resurfaced during the year to improve the riding quality of the original asphaltic concrete surface.



The high water on January 31, 1963, destroyed the Yuba River Bridge on Sign Route 49 west of Downieville. Thirteen days later a single 120-foot welded plate girder replacement span had been designed and constructed and was carrying traffic.

Plans are also underway to provide maintenance elevators at the Dumbarton lift span, to eliminate the need for raising the span to take personnel and equipment to the tower tops, with the resultant delay and inconvenience to traffic.

The Division of San Francisco Bay Toll Crossings continued operations which will ultimately result in increasing the width of the San Mateo Bridge and the replacement of the lift span by a high-level structure. During the year a three-mile length of new four-lane structure was opened to traffic.

The lift span operation was continued at both bridges, as required by Federal Law. During the year there were 2,292 lifts at the San Mateo-Hayward Bridge and 1,041 lifts at the Dumbarton Bridge.

Emergency tow service was instituted at the San Mateo-Hayward Bridge to improve safety and minimize delays to traffic.

Carquinez Straits Bridges

A total of 13,697,648 vehicles used the Carquinez Bridge during the year and $4,681,278 was collected. This was a 2.9 percent decrease in traffic and a 2.5 percent decrease in revenue over the previous year. These decreases were caused by diversion of some of the traffic to the new Benicia-Martinez Bridge and by a long rainy season. The combined traffic for Carquinez and Benicia-Martinez Bridges amounts to an increase of 8.2 percent over the previous year's traffic for Carquinez Bridge.

A contract for repairing damage that occurred to the Pier 3 fender when it was hit by a barge was completed during the year.

The principal bridge maintenance at the Carquinez facility consisted of the paint maintenance program. Most of the work involved the west bridge, but an increasing amount of work is being required on the east bridge.

The new Benicia-Martinez Bridge was officially opened to traffic on Saturday, September 15, 1962, at 12 noon, and toll collection was begun at 12:01 a.m. on September 16, 1962. As of June 30, 1963 the span had carried 1,563,749 vehicles, producing a total revenue of $465,092 since toll collection was begun.

STATE TOLL CROSSINGS DIVISION IS REORGANIZED

Responsibility for planning and constructing future transbay crossings in the San Francisco area and other major port areas in California, plus the maintenance and operation of existing toll bridges has been assigned to an expanded State Division of Bay Toll Crossings.

State Director of Public Works John Erreca has appointed E. R. "Mike" Foley, a state bridge and highway engineer since 1932, as the division's chief engineer.

Purpose of the reorganization of the State's toll bridge functions, Erreca said, is to eliminate the "divided responsibility" which has been in effect since the Division of San Francisco Bay Toll Crossings was established in December 1947 by administrative order. The Legislature this year established the division as a statutory unit of the Department of Public Works and revised its title.



E. R. FOLEY

Since 1947 the Division of San Francisco Bay Toll Crossings has been planning, designing and constructing some of the State's toll bridge projects, such as the Richmond-San Rafael Bridge, the current widening of the San Mateo-Hayward Bridge and the reconstruction of the San Francisco-Oakland Bay Bridge. The Division of Highways has been operating and maintaining these bridges with state highway funds and has designed and constructed other toll structures, notably the Carquinez parallel bridge, the Benicia-Martinez Bridge, and the new Vincent Thomas Bridge between San Pedro and Terminal Island.

In addition, the Division of Bay Toll Crossings has been conducting preliminary studies for other crossings, such as the Southern Crossing of San Francisco Bay and a Marin-San Francisco crossing, while the Division of Highways has carried on studies for a proposed crossing structure between San Diego and Coronado and for a possible crossing of Humboldt Bay in Northern California.

Under Erreca's order, which became effective November 18, 1963, the new Division of Bay Toll Crossings, under Foley, assumed responsibility for all of these functions, incldng toll collection, maintenance, planning studies for new crossings, and design and construction of new bridges.

Foley, the new division chief, has been district engineer for the Division of Highways, with headquarters at San Luis Obispo, since April 1961. For five years before that he was district engineer at Bishop.

Foley, a native of Nevada City, joined the Division of Highways shortly after graduation from the University of California as a civil engineer in 1932. Most of his first 10 years were spent in bridge design and construction work.

After four years of U.S. Navy service in World War II, including two years as an officer with the Seabees in the South Pacific, Foley returned to the Division of Highways and was active in bridge construction until 1950. He was then transferred to other duties, and just prior to his promotion to district engineer in 1956 was in charge of a statewide county road inventory and mapping project.

The former Division of San Francisco Bay Toll Crossings, which is being incorporated into the new division, was headed until last July by Norman C. Raab as projects engineer.

Charles L. Sweet, Division of Highways bridge engineer in charge of operating and maintaining state-owned toll bridges, will continue in his present capacity under the new division.

Personnel & Information

The functions of personnel, training, safety, audio-visual services and public information are grouped administratively under the direction of the engineer in charge of Personnel and Public Information

PERSONNEL

As of the end of the 1962-63 fiscal year, total Division of Highways staff was 16,944 employees, an increase of approximately 900 over the previous year. About 400 of this increase was in engineering classes, with other increases occurring in accounting, clerical, programmer and maintenance classes.

On July 1, 1963, there were 8,648 engineering employees, 4,144 maintenance employees, 559 right-of-way agents, 493 equipment repair employees and 3,064 in accounting, clerical and miscellaneous functions.

A civil service candidate for highway maintenance man II is given a performance test on equipment he will be required to operate on the job.



Recruitment Efforts

In the recruitment of employees, several fields were covered. More than 500 job offers were made to graduating engineering students by our recruiters in schools all over the United States. About 185 of these have now reported and been assigned to the junior civil engineer job rotation program consisting generally of six months in construction, six months in design, six months in surveys and six months in one of the other engineering functions of the division. A comparable number completed their two-year rotation program and have been placed in regular assignments.

Recruitment efforts for junior right-of-way agents were stepped up to tie in with a new long-range training and development program. Recruitment of accountants and electronic data processing programmers continues to be a problem. Performance examination procedures for new maintenance men were improved. In many of the areas where recruitment difficulties are being experienced, the inequity of state pay scales appears to be a major part of the problem.

Programs Completed

As a result of the Personnel Management Report on the Division of Highways issued by the State Personnel Board in November of 1962, a number of programs were firmed up and completed. Since there was active participation by division staff in the study and the consequent report, many of these developments such as improved sick leave administration and better classification techniques were started before the report was completed. Still under study are improved reporting procedures for overtime and more easily understood standards on various levels of engineering positions.

Other projects that have been completed or studied include organization of the landscape function, conversion to electronic data processing and resulting organizational changes, staffing standards for maintenance field offices, accounting department reorganizations, and a revised classification structure and function of the Equipment Department field shop offices.

Classification Studies

Specific classification studies are underway in the series of radiotelephone technician, highway traffic signal technician, and highways administrative officer. Nine new classes were established during the year, and a number of class specifications were revised to reflect current needs.

During the year, 20 employees were dismissed—13 from permanent positions. Twenty-four were rejected during probation, four were demoted

and forty were suspended. A total of 232 employees retired. Ninety-five 25-year awards were given, making a total of 2,221 for the division.

During this year, 197 visitors from 35 countries were guests of the division, generally under the auspices of federal government programs. Discussions and training programs, varying from a few hours to several months, were arranged for each individual.

TRAINING

Training activities participated in by Division of Highways employees can be classified into three broad areas: inservice training, outservice training, and on-the-job training. The Division Training Section is responsible for all formal training given to Highways employees.

Inservice Training. To determine inservice training needs, the members of the training staff consult with district and headquarters supervisors and managers. The training staff then works with districts and departments to work out content and format of a formalized program designed to meet recognized needs. Depending upon course content, the instruction staff may be composed of the division training staff, organizational unit staff, outside technical experts, or a combination of these.

Outservice Training. Outservice, or "specialized" training, includes courses which are developed and presented by training facilities outside the state civil service. Selected Highways employees attend these courses in order to develop needed skills which cannot be obtained through inservice training programs.

On-The-Job Training. On-the-job training consists of learning processes which are guided by the employee's supervisor. The Training Section directs the individual development program for the division and consults and assists supervisors and managers in formulating both self-development and employee-development plans. The Training Section administers the planned two-year rotation program for junior civil engineers, in which planned rotation and experience is combined with on-the-job training (as described in the May-June, 1963, issue of *California Highways & Public Works*). Six hundred junior civil engineers took part in the two-year rotation program this year.

During the year division employees participated in 198,842 man-hours of training. Subject areas included orientation, supervision and management, professional and technical, engineering and right-of-way, maintenance, and clerical.

Supervision and Management

A total of 1,790 management and supervisory personnel completed a total of 28,624 man-hours of training.

The management and supervision course for professional and technical supervisors was taken by 285 employees in various districts. The 14-session, 70-hour course is designed to improve managerial talent in preparation for more responsible assignments.

A two-day course in data processing for highway managers was given to 49 of our top-level management in December 1962. This course was developed by the Training Section and instructors from private industry and outside educational institutions participated with division personnel in giving the training.

Seventeen top level managers participated this year in the Interagency Management Development Program sponsored by the Governor's Committee on Personnel and Training. Nine of these attended the annual Management Development Conference at Davis in July. This year's course title was "Management by Objectives." Examples of other management development courses our managers are participating in are "Fiscal Management for Administrators," and "Administrative Law."

Technical and Professional

A wide variety of courses was given throughout the division in the professional and technical fields. Some examples of division-wide programs are listed below:

The University of California's Institute of Transportation and Traffic Engineering at Berkeley presented a series of "short courses" which were attended by Highways employees. Fifty-five construction inspectors completed one such course designed to acquaint them with current developments and procedures in their line of work. One hundred seventy-eight of our engineers attended "Soil Engineering—Street and Highways Applications."

A course was initiated and given in the districts this year for 458 accounting personnel, to orient these employees to basic developments in electronic data processing.

A total of 10,075 district personnel participated in 136,603 man-hours of training developed and conducted within the districts. Some examples of district-originated courses given this year are:

District III's super orientation course designed to train newer engineers. The course includes a study of division functions, a review of mathematics, engineering drawing and surveying, and a coverage of highway planning, design, and construction processes.

District VII completed a program for field control and record testing personnel. It covered test procedures, methods of sampling, construction procedures, rock plant operations and test record maintenance.

District IV developed a program to introduce professional-technical personnel to critical path planning methods.

Specialized Programs

Forty-seven division employees participated in specialized (outservice) training this year. Twelve of these attended a five-day course, "Fundamentals of Traffic Engineering," which was presented by I.T.T.E.

Other courses of a specialized nature which were given included "Real Estate Appraisal," "Motor Vehicle Fleet Supervision," "Motor Vehicle Fleet Maintenance," and "Asphalt Paving and Construction."

EMPLOYEE SAFETY

The Safety Section obtains statistical information, promotes safety and develops and makes accident prevention methods and procedures available to operating departments.

Safety Supervisors

Each of the 11 districts has a full-time safety supervisor. Part-time safety supervisors are assigned to the Bridge Department, State-owned Toll Bridges, Service and Supply, Materials and Research, and the Equipment Department. They serve as secretaries to the district and department safety committees, investigate accidents and work methods, recommend procedures and protective devices which may assist in accident prevention, and perform other duties recommended by the safety committees.

Committees Appointed

Committees are appointed in each district and major department to review motor vehicle and industrial accidents and to recommend appropriate action to prevent reoccurrence. They also review the district safety program and make recommendations to improve its effectiveness.

Accidents Are Coded

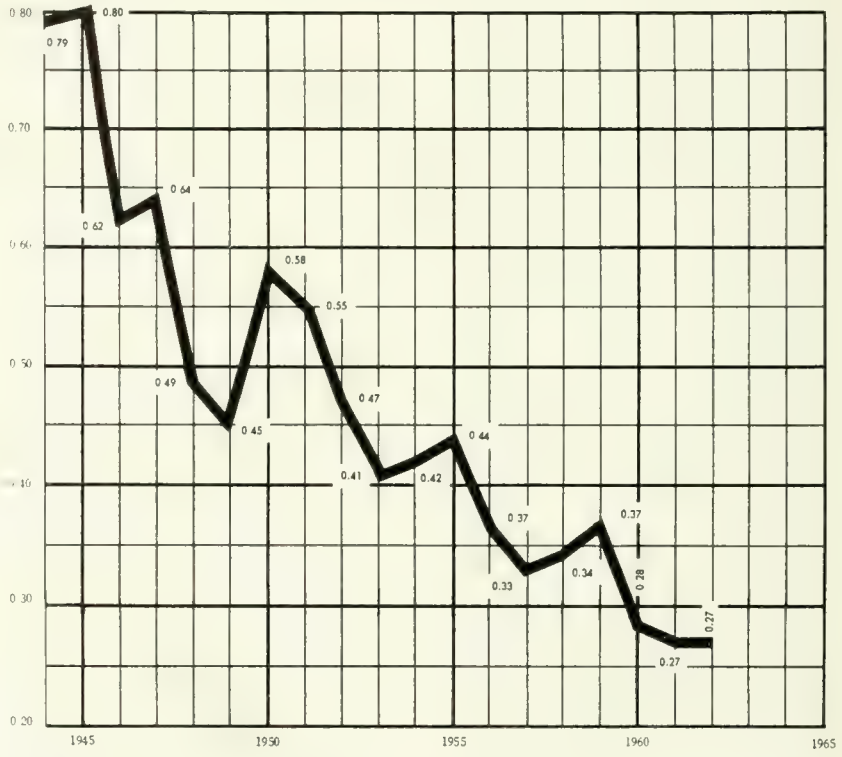
All accidents involving Division of Highways personnel or equipment are coded and processed by electronic machines to develop annual statistical reports. The American Standards Method of Recording and Measuring Work Injury Experience is used for reporting and recording of accidents. Frequency and severity rates are compiled monthly and compared to previous monthly and yearly rates to determine program effectiveness.

Records

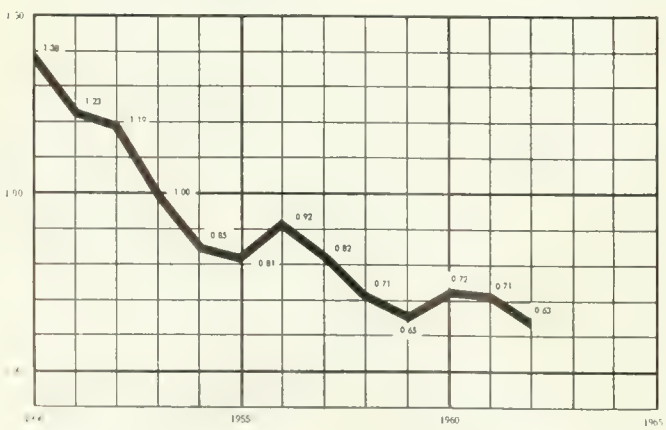
Since the establishment of the Safety Section the frequency rate for both industrial injuries and motor vehicle accidents has shown an almost continuous decline. For example, the frequency rate for industrial injuries in 1941 was 49.85 and in 1962 was 11.66. The frequency rate for motor vehicles has been reduced from 1.38 in 1950 to 0.64 in 1962.

The reduction in the personal injury frequency rate has been accompanied by a reduction in compensation insurance payments. In 1945 the

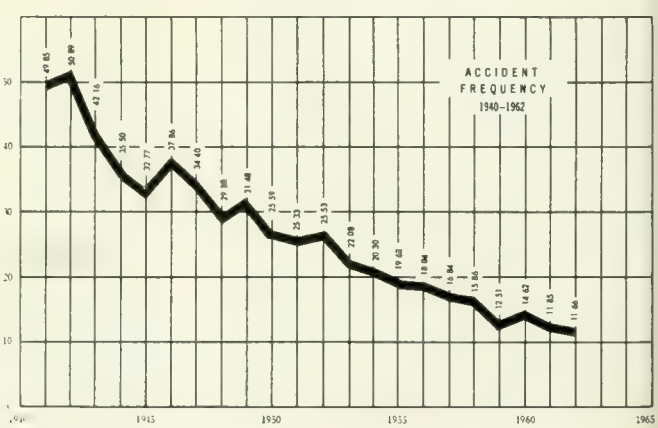
COMPENSATION INSURANCE PAYMENTS PER $100 OF PAYROLL



MOTOR VEHICLE ACCIDENT FREQUENCY



PERSONAL INJURY



insurance rate per $100 of payroll was 0.80 and in 1962 it was 0.27.

The frequency rate for personal injuries is the number of lost-time accidents per million working hours of exposure. For motor vehicles, the frequency rate is the number of recordable accidents per million vehicle miles.

Driver Training

All employees who drive a Division of Highways motor vehicle at any time have been given a special course in "Defensive Driving Techniques." They must complete the lecture and psychophysical test within three months of employment. New employees are also given a driver observation run before being allowed to drive a state car.

When an employee has had three or more accidents in any one year and his driving record at the Department of Motor Vehicles indicates a number of other accidents and citations, he is given supplemental driver training and counseled regarding his driving ability and/or attitude. If these steps prove ineffective he may be grounded or disciplined.

Driver Training Record

Number of new employees given driver training	2,143
Number of employees given special training	11
Total number of all employees who drive state vehicles in performance of their duties	11,750

Fire Prevention

Fire extinguishers were demonstrated at various maintenance stations and employees were encouraged to try out the equipment. This is a continuing program to familiarize employees with modern extinguishers and their use.

Employees Suggestion Program

Suggestions from the Merit Award Board have increased in about the same ratio as the number of employees. This program is handled by the Safety Section and the record for the 1961-62 fiscal year is as given below:

Total number of suggestions	513
Total given cash awards	103
Total granted for cash awards	$4,307
Total "Certificates of Commendations" issued	37
Total amount of estimated savings resulting from adopted suggestions	$61,039.21

State Liability for Damage Claims

The Safety Section co-ordinates its program of accident investigations with the Legal Division and the districts if the division may be involved in damage claims.

AUDIO-VISUAL

The Audio-Visual Section produces a wide variety of material for employee training and public information.

The section maintains an extensive library of colored slides on highway scenes and operations for use in training and public information presentations. It also maintains a variety of projection and recording equipment for use throughout the division. The section also advises the district offices and departments on equipment needs.

Some of the more outstanding accomplishments of this section during 1963 were: publications or reports on "Urban Transportation Planning Conference, Scenic Highways, Legislators Facts, Flagging Manual (Employee Safety)"; National Engineers' Week Exhibit (Sacramento), Career Day display (Eureka), State Fair exhibit (Sacramento); transparency and slide presentation for the Right of Way Training Academy; sound color motion picture of the Governor's opening of the San Diego Freeway in Los Angeles; and the five-section color sound motion picture on "Concrete Testing Procedures" for training Construction Departmnet inspectors.

PUBLIC INFORMATION

Interest in highway matters was widespread in California during the year and expressed itself in dedications and ribbon cuttings on completed projects throughout the State, attendance at public hearings, extensive press comment and many individual inquiries.

Attracting statewide interest as a boon to every traveler bound in or out of western Los Angeles to or from the north was the opening of the San Diego Freeway between West Los Angeles and the San Fernando Valley. This 5.7-mile section through Sepulveda Canyon in the Santa Monica Mountains was built as part of an 11.9-mile project costing more than $20,000,000. It was opened to traffic following ceremonies Friday, December 21, 1962.

Another through route completion of interest was the opening early in November 1963, of the final segment of the Golden State Freeway between the East Los Angeles Interchange and north of San Fernando.

The 6,060-foot Vincent Thomas Toll Bridge between San Pedro and Terminal Island opened to traffic November 15, 1963. It is the first major suspension bridge in Southern California and the third largest in the State. A celebration prior to opening was held in conjunction with the San Pedro Fishermen's Festival. A booklet describing engineering features of the project was prepared by the division.

Far to the north near the Oregon border crowds turned out Saturday, July 27, to mark the opening of the Randolph Collier Tunnel through Oregon Mountain on U.S. Highway 199. The 1,835-foot bore eliminated 128 curves, five hairpin switchbacks and a steep grade between Crescent City and Grants Pass. Its cost was $7,500,000.

Although these opening ceremonies were arranged by local civic groups, information on the events and the projects were furnished by the Division and its district offices to communications media, and both routine and special news releases were used extensively. Many inquiries by specialist writers were answered and a large number of photographs were made available.

Thousands of Californians viewed a freeway exhibit at the 1963 State Fair, which featured color photographs and a model of the 29th-30th



Fairgoers inspect the exhibits and ask questions at the division's booth at the State Fair in Sacramento.

Street Freeway in Sacramento which will connect the existing South Sacramento and Elvas Freeways.

The Division of Highways and its district offices co-operated in observation of the third annual National Highway Week (May 26-June 1, 1963). Through the media of press, radio, television, speeches, and graphic displays hundreds of thousands of Californians were enabled to know more about their state highway system.

A special Southern California National Highway Week Committee was in operation in the Los Angeles area where the observance was highlighted by the dedication on May 28 of a key section of the San Diego Freeway. There were special displays in many other parts of the State, including a traveling exhibit of color projections in the San Francisco Bay area. Many newspapers published a specially prepared progress report on the highway system.

Publications

The bimonthly magazine *California Highways and Public Works* continued as the principal publication of the Department of Public Works and the Division of Highways. While its main distribution is in California to employees of the division and other interested persons, there was a growing demand for it in other states and foreign countries. Numerous articles from the magazine were reprinted and many photographs were furnished to editors and writers for foreign and domestic publications.

Public information material issued in published form included, in addition to regional material prepared by the various districts:

"California Highways—1962," a 12-page illustrated reprint from *California Highways and Public Works* magazine constituting a concise, nontechnical version of the division's annual report.

"California's Freeway Planning Team," a leaflet prepared principally for the use of legislators and public service organizations in explaining highway planning procedures.

"Freeway Facts," an illustrated booklet containing basic information about freeways and route adoption procedures, widely used at district public hearings (revised in August 1963).

Reprints of articles and district roundups published in *California Highways and Public Works*, used as informational mailing pieces to answer a wide range of inquiries.

"Clip Sheet," which provides information for use in employee publications issued by each district and some headquarters departments.

News releases on routings considered and acted on by the California Highway Commission totaled 86 during the fiscal year, of which 33 were accompanied by maps specially prepared for newspaper reproduction. This was in addition to previous extensive publicity given to route hearings at the district level. Advance publicity was also given eight public hearings scheduled by the Commission.

Other News Releases and Media Contacts

The quantity and scope of news releases issued by the division continued to increase, especially on the part of the district offices.

Information on the highway program was also issued through telephone calls, office interviews, correspondence and appearances by division personnel on radio and television programs, and before local civic organizations and service clubs.

Right-of-Way

The responsibility of the Right of Way Department is to provide land for the construction of state highways. This involves appraisal, acquisition and management of properties required for highway purposes, removal of all buildings and relocation of utility facilities prior to construction. Each of these activities is handled by a special operational unit

Right of Way Engineering

Right of Way Engineering produces the basic working tools consisting of maps for the appraisers, deeds and subordinate documents for the negotiators, legal documents for condemnation, record maps and documents for administration, and director's deeds, relinquishment and abandonment documents for the disposal of excess properties.

Data are supplied in the form of: maps from Design, showing centerline and the minimum width of right-of-way needed for a proposed highway; survey notes tying in features on the ground; and ownership information searched from public records. From such information Right of Way Engineering determines the precise amount of land required from each ownership along the proposed highway route.

After the area has been determined and calculated, maps are prepared for the appraisal unit to start the acquisition process.

Appraisal

The first step in the acquisition process is the determination of just compensation—the amount of money an owner is entitled to in the transfer of his property to the public. A staff of skilled appraisers determine the value of a property by comparing it with sales of similar properties in the same neighborhood. They inspect each property thoroughly, analyze variations in price, weigh good and bad features, and check all items which tend to create value on the open market.

During the 1962-63 fiscal year, the Right of Way staff appraised 8,493 separate parcels and completed appraisal reports with a total valuation of $150,742,325. The average parcel took nearly four days to appraise and had a value of $17,750.

Of these parcels, nearly half were partial takings, leaving a remainder in private ownership. In these circumstances, the appraiser must also determine the extent of damages or benefits to the remainder. Right of Way appraisers have been researching this subject for several years; they have compiled the largest file of remainder parcel resale examples in the United States. These sales provide an objective reference in the determination of damages and benefits; the use of the open market assures the property owner of fair and equitable treatment.

Acquisition

The completed appraisal report is the basis for negotiations with the property owner. Since great care has been taken during the appraisal process to determine fair market value, then only a settlement at that value can be fair and equitable to the State, the taxpayers, and the property owner.

A southerly view along future Interstate 680 in Alameda County where early adoption of the freeway route permitted planned development of San Ramon Village residential areas around rights-of-way reserved for future freeway construction.



The Acquisition Unit's most important tool is an accurate appraisal report.

The accuracy of our appraisal reports is reflected in our acquisition record. During the 1962-63 fiscal year, 8,131 parcels were acquired for highway right-of-way. Expenditures were $145,510,858—an average of $17,895 per parcel.

Since property owners are customarily allowed a reasonable time to consider the State's offer and to relocate, there is usually a lag, from year to year, between the number and total value of parcels appraised and the number and value of parcels acquired. Nevertheless, it is interesting to note the close correspondence in the average value of parcels appraised and the average value of parcels acquired. The difference amounts to $145—less than eight-tenths of 1 percent of average value.

Another indicator of the success of the right-of-way program is the small number of parcels acquired through condemnation proceedings. During this fiscal year, of 8,131 parcels only 220 were acquired through contested court actions. This amounts to 2.7 percent, a figure that has remained fairly constant through the years. The other 97.3 percent of acquisitions were by amicable agreement between the property owner and the State.

The negotiator's primary function is, then, to assure a fair deal for *all* parties; he must represent not only the State and the taxpayers, but also protect the interests of the property owners. He must assure that the property owner receives fair market value —neither more nor less. The record indicates that, again this year, this primary goal has been achieved.

Property Management

Highway projects are scheduled to allow property owners adequate time to carefully consider the State's offer to purchase and, then, after purchase, time to relocate their household or business. Consequently, a property may be available for rental or lease prior to removing all improvements in preparation for construction.

The Property Management Unit is responsible for rentals, leasing, relocation advisory assistance, clearance and excess lands disposal.

Property Management returns approximately $12,800,000 to the State Highway Fund annually. This income results from: interim rental and leasing of approximately 5,000 properties which produces more than $4,000,000 annually; the sale of approximately 2,000 unimproved parcels of excess land returns about $6,800,000 annually; and the sale of 4,000 major improvements, nearly $2,000,000 annually.

Improvements which cannot be sold are scheduled for demolition and an average of 360 demolition contracts are let annually on the basis of bids totalling about $720,000.

The Relocation Advisory Assistance Program, established last year, has continued to provide assistance and advice, upon request, to all persons involved in the highway right-of-way clearance process. It functions to minimize hardships which might stem from inability to find suitable new homes and business locations.

Utilities

The Right of Way Department, as part of its clearance responsibilities, must make provision for the removal or relocation of utility facilities which may be affected by highway projects. This activity includes predesign liaison with utility companies to insure against economic waste where new utility facilities may conflict with highway plans.

Through mutual planning and cooperation, millions of dollars have been saved by both Highways and the utility companies. During the fiscal year, Right of Way concluded 743 agreements requiring adjustment of utility facilities. These agreements involved a highway expenditure of $11,750,044.

Other Acquisitions

The department, under contractual agreements, handles acquisition of property for other state agencies, such as the Department of Water Resources and the Department of Finance. During the fiscal year 430 nonhighway parcels with a total value of $10,136,109 were acquired. In summary, then, Right of Way acquired and expended this year:

	Parcels	*Value*
Highway right-of-way	8,131	$145,510,858
Utility agreements	743	11,750,044
Other acquisitions	430	10,136,109
Total	9,304	$167,397,011

Administration

During the year several important changes were initiated in Administration. For example, the headquarters office was reorganized, a new training program was inaugurated, and a new research unit was created.

1. *Headquarters Office Reorganization*

Because of the growth and increasing urbanization of California in the past several years, the overall right-of-way program has grown exceedingly complex. To deal with the growing complexities, to maintain standards of operational efficiency with low operational costs, the headquarters unit was critically analyzed, and on the basis of that analysis, reorganized

The headquarters staff now administers the right-of-way program not on a geographical but on a functional basis; i.e. appraisal, acquisiton, etc. This permits the staff to supervise the functions in greater depth, to recognize strong and weak points in operational procedures, and to suggest areas where greater economies of operation might be achieved or procedures might be improved.

2. *Personnel and Training*

The loss of experienced personnel to other organizations has increased at an alarming rate in recent years. During this year the department lost 75 experienced right-of-way agents or approximately *14 percent* of its total. Last year the rate was *9 percent;* the year before, 7 *percent*. Since it takes at least three years for even the best new agent to attain the associate, or journeyman level, the department must maintain a constant and intensive training program for new agents.

As a first step in offsetting these staff losses, the department, with the co-operation of the State Personnel Board, carried out an intensive recruitment program on college campuses throughout the State. This program culminated in the Right of Way Academy—two weeks of intensive training for new agents—held in August of 1963 at the Davis Campus of

the University of California (see *California Highways and Public Works*, September-October 1963).

This first Right of Way Academy is primarily an improvement and intensification of the established intraining program for junior right-of-way agents. This improvement, however, will only solve part of the personnel problem. The attrition rate in the ranks of experienced personnel threatens grave consequences to the continued success of our acquisition program—the loss involved 9 percent of the management ranks and 10 percent of the journeyman ranks. The department is now planning advanced level academies in an effort to regain the necessary experience level.

During 1962-63 more than 25,000 classroom and home study hours were devoted to right-of-way instruction. This figure must increase significantly in coming years.

3. *Research and Development*

A third change was the creation of a Right of Way Research and Development unit. The duties of this unit absorbed the responsibilities of the former Land Economic Studies Section and added the responsibilities of Operations Research and Methods Development.

The unit is charged with providing much of the raw data required by management in the decision-making process. For example, during the past fiscal year, this unit has carefully analyzed such variables as land use, type of taking, and length of negotiations on each of the 8,131 parcels acquired. This has provided management with objective information to estimate lead time, to predict staffing, and to predict operational costs under the varying conditions of the right-of-way program.

Of course, the land economic function has continued as a vital research effort. This year the research emphasis shifted in response to the needs in planning activities. For example, in highway location problems, Advance Planning considers how alternate route proposals may affect, among other factors, community values and land use. This year Right of Way's major research efforts have been in the analysis of the economic component of community values and land use changes to provide objective data for planning decisions. This research is directed toward the prediction of economic impact and how it may vary with alternate route proposals.

Additionally, the unit produced *Community Benefits – A Suggested Method of Analysis* which is a discussion of the methodology of highway socioeconomic impact projection. This publication will serve as a useful tool, not only to those right-of-way agents doing impact research, but as a tool for engineers in Advance Planning in the interpretation and integration of the economic material in right-of-way reports.

Conclusion

Fifteen hundred employees contributed their efforts to a successful completion of the right-of-way program in the 1962-63 fiscal year. An average 540 right-of-way agents, 550 right-of-way engineering people, and 430 clerical and accounting personnel worked throughout the State to carry through the multiple responsibilities of the Right of Way Department.

Legal

The Division of Contracts and Rights of Way is the legal division of the Department of Public Works and renders a variety of legal services to the department and its Division of Highways

The following tabulations indicate the volume of work performed by the legal division involving court appearances before various administrative agencies for the past year.

Condemnation Proceedings

Some idea of the volume of the condemnation casework is given by the following tabulation. (The parcel count is based on a count of parcels in condemnation resolutions.)

Suits filed	583
Parcels involved	2,868
Defendants involved	16,151
Suits closed	467
Contested trials	220
Uncontested judgments	384
Default judgments	27
Suits pending 7/ 1/62	888
Suits pending 6/30/63	1,004

There was a notable increase in suits filed as compared to the previous fiscal year—a 13 percent increase from 516 to 583. The total suits closed, 467, represented total awards of $23,871,-931.47 and represented 1,235 days in court.

Appellate Cases

During the fiscal year a number of appellate court briefs were written by the legal division and various appeals were argued. Decisions were rendered in *People* v. *Forster*, 58 Cal. (2d) 257 (23 Cal. Rptr. 582); *Thelander* v. *Superior Court*, 58 Cal. (2d) 811 (26 Cal. Rptr. 643); *Peter Kiewit Sons' Co.* v. *Pasadena City Junior College Dist.*, 59 A.C. 253 (28 Cal. Rptr. 714); *Eden Memorial Park Assn.* v. *Department of Public Works*, 59 A.C. 431 (29 Cal. Rptr. 790); *Healy* v. *Brewster*, 59 A.C. 473 (30 Cal. Rptr. 129); *People* v. *Valley Drive-In Theater Corp.*, 206 Cal. App. (2d) 309 (23 Cal. Rptr. 626); *People* v. *Mascotti*, 206 Cal. App. (2d) 772 (23 Cal. Rptr. 846); *People* v. *Gutierrez*, 207 Cal. App. (2d) 529 (24 Cal. Rptr. 441); *Consumers Holding Co.* v. *County of Los Angeles*, 208 C.A. (2d) 419 (25 Cal. Rptr. 215); *Reid* v. *State*, 208 Cal. App. (2d) 725 (25 Cal. Rptr. 535); *People* v. *Alexander*, 212 A.C.A. 85 (27 Cal. Rptr. 720); *People* v. *Hayward Building Materials Co.*, 213 A.C.A. 487 (28 Cal. Rptr. 782); *Perati* v. *Atkinson*, 213 A.C.A. 502 (28 Cal. Rptr. 898); *People* v. *Lipari*, 213 A.C.A. 514 (28 Cal. Rptr. 808); *People* v. *Hartley*, 214 A.C.A. 406 (29 Cal. Rptr. 502); *People* v. *Lagiss*, 216 A.C.A. 148 (30 Cal. Rptr. 852); *People* v. *Salem Development Co., Inc.*, 216 A.C.A. 708 (31 Cal. Rptr. 193).

Perhaps the most significant of these decisions is *Eden Memorial Park Assn.* v. *Department of Public Works.* The Supreme Court upheld the right of the department and the State Highway Engineer to request the Secretary of Commerce to acquire certain cemetery land for the State to complete a freeway on the Interstate Highway System. Prior efforts of the department itself to acquire this property were unsuccessful when the district court of appeal held in *Eden Memorial Park Assn.* v. *Superior Court*, 189 Cal. App. (2d) 421 (11 Cal. Rptr. 189) that certain provisions of state law precluded condemnation of cemetery property.

The legal division also filed amicus curiae briefs in two construction contract cases, *Peter Kiewit Sons' Co.* v. *Pasadena City Junior College Dist.* and *Healy* v. *Brewster.* In the former case, the Supreme Court held that the rule against apportionment of liquidated damages for delay in completion of the work is not applicable to contracts which provide procedures for extensions of contract time or apportionment of liquidated damages. The latter case was concerned with whether a contractor is entitled to recover for additional costs resulting from unknown subsurface conditions. The Supreme Court did not answer this question and decided the case upon other grounds.

In *Thelander* v. *Superior Court*, the Supreme Court held that although the 1961 moratorium legislation suspends a party's right to bring a tort action against the State to trial until after the close of the 1963 Legislative Session, the State is nevertheless required to file an appearance to the complaint within the usual time prescribed for ordinary actions. The court pointed out that if additional legislation is enacted during the moratorium period making governmental immunity applicable in such cases, a judgment on the pleadings in favor of the State would be proper.

Perati v. *Atkinson* involved a most unusual set of facts. Plaintiff, a civil service toll collector, brought suit against his toll sergeant for intentional infliction of emotional distress. The sergeant had directed plaintiff to stop an automobile as the driver was suspected of intoxication. When plaintiff failed to do so, the sergeant entered this fact in his official log. The court ruled that these circumstances did not give rise to a cause of action since the sergeant's conduct could not be regarded as "outrageous" or "beyond all reasonable bounds of decency." The judgment of dismissal by the trial court was affirmed.

In *People* v. *Hayward Building Materials Co.*, the court held that a property owner in a condemnation proceeding was not entitled to an award for the cost of restoration of his remaining property in addition to severance damages. Such costs of restoration merely constitute evidence bearing on severance damages. And in *People* v. *Salem Development Co., Inc.*, it was held that a property owner was not entitled to interest from the date the order of immediate possession was signed and filed but only from the "effective" date of the order, which first required service of a notice upon the property owner. Since the notice was never served and possession was not taken until after trial and judgment, no interest was allowed.

Several other cases are now pending before the appellate courts, awaiting argument or decision.

Other Litigation

In addition to the condemnation proceedings, the department's attorneys handled a large number of miscellaneous cases. The following tabulation covers a wide variety of litigation and indicates a continuing increase in this aspect of the department's work.

At the start of the fiscal year there were 659 cases pending, and 519 cases were filed during the year, for a total of 1,178 cases being processed. There were 420 cases closed during the year, leaving 758 cases pending on June 30, 1963.

Some of these cases involve claims for damage to state highway facilities, such as bridges, signals, guardrails, or damage to state vehicles, or unlawful detainer actions. During the fiscal year collections from these cases by the division amounted to $105,190.76.

The case total includes many cases where the department was represented as a defendant, such as inverse condemnation, suits by contractors for additional compensation on construction contracts; proceedings for damage to public property by reason of state highway operations; suits filed because of alleged dangerous or defective condition of highways; and suits enjoining the construction and building of highways. Other types of suits, such as stop notice actions, are defended by the department and the department has filed interpleader actions in which it assumes a neutral position between the contractor and the party suing on a stop notice.

Proceedings Before Public Utilities Commission

The division handles matters before the Public Utilities Commission having to do with crossings of grade at highways and railroads and the construction of grade separations. The following tabulation indicates the volume of this type of work for the fiscal year:

Applications pending, June 30, 1962	11
New applications filed	30
Total applications before PUC	41
Applications processed to completion prior to expiration date of order	1
Adjusted total applications	40
Decisions received	30
Applications pending, June 30, 1963	10

In addition to formal applications, 18 proceedings under PUC General Order 88, relating to crossings at grade, were processed. In all instances the approval of the Public Utilities Commission must be obtained as to engineering details and, in the event of a failure to reach an agreement with the railroad involved as to apportionment of cost, the applicant seeks such determination by the Public Utilities Commission. The enactment by the Legislature in 1957 of a new formula for apportionment of cost, except for federal-aid highways, has substantially reduced the number of contested cases.

Board of Control and Other Claims

Claims against the State by reason of activities of the department are filed with the State Board of Control. The following tabulation illustrates the increase in the volume of this work:

	Number of claims	*Amounts of claims*
Pending on 7/1/62	102	$8,217,096.80
Filed	309	14,903,130.81
Total	411	23,120,227.61
Claims disposed of	258	10,642,553.34
Pending 6/30/63	153	$12,477,674.27

There was an increase of 31 claims filed over the previous year, amounting to $3,041,591.56. This was an increase of 11 percent. The principal types of Board of Control claims as listed above are for negligence, dangerous or defective condition of state highways, breach of contract and inverse condemnation.

Other claims filed with the department and its employees and the Governor number 46.

The primary reason for the increase in the number of claims filed with the board is due in a large part to the recent decision by the California Supreme Court in the case of *Muskopf* v. *Corning Hospital District*, 55 Cal. (2d) 211.

This decision greatly expanded the liability of the State, particularly for accidents arising out of the dangerous or defective conditions of state highways. The 1963 Session of the Legislature enacted Chapter 1681 which greatly expands the liability of the Department of Public Works. The legislation makes the State liable for the negligent acts or omissions of its employees as well as for the dangerous condition of public property, including state highways. This liability will necessitate the careful investigation by Division of Highways personnel of all claims.

It is anticipated that because of the *Muskopf* decision and this legislation, the number of claims will increase substantially as well as the work in investigating these claims and the handling of the resulting litigation.

Contractors' claims before the State Highway Engineer's Board of Review for additional compensation have continued to increase. These claims have required considerable work, both in the analysis and handling of claims as well as the resulting litigation. Directly proportional to the number of Board of Review hearings in the increased number of lawsuits against the department arising out of construction contract claims.

House Counsel Work

The "house counsel work" of the division has also continued to increase. This work consists of legal opinions directed toward *preventing* litigation.

Other routine work has increased, such as approval of contracts and leases, reviewing forms and accident reports. This work is directly proportional to the increased volume of the highway program. In addition, there were 30 contested hearings before the State Personnel Board, an increase of 5 over the previous fiscal year.

Fiscal Management

Administration of all accounting activities of the Division of Highways is under the direction of the Comptroller of the Division of Highways and his staff

Cash Resources and Obligations

As the State Highway Fund (SHF), has no borrowing authority, it must operate on a cash basis. This requires the maintenance of sufficient working capital to meet payrolls and payments to contractors. Monthly cash outlays have peaks and valleys which do not coincide with fluctuations in monthly transfers into the SHF. May and June 1963 were the highest income months of the year because of the receipt of:

(1) Approximately $55,000,000 in SHF share of the annual motor vehicle receipts, and

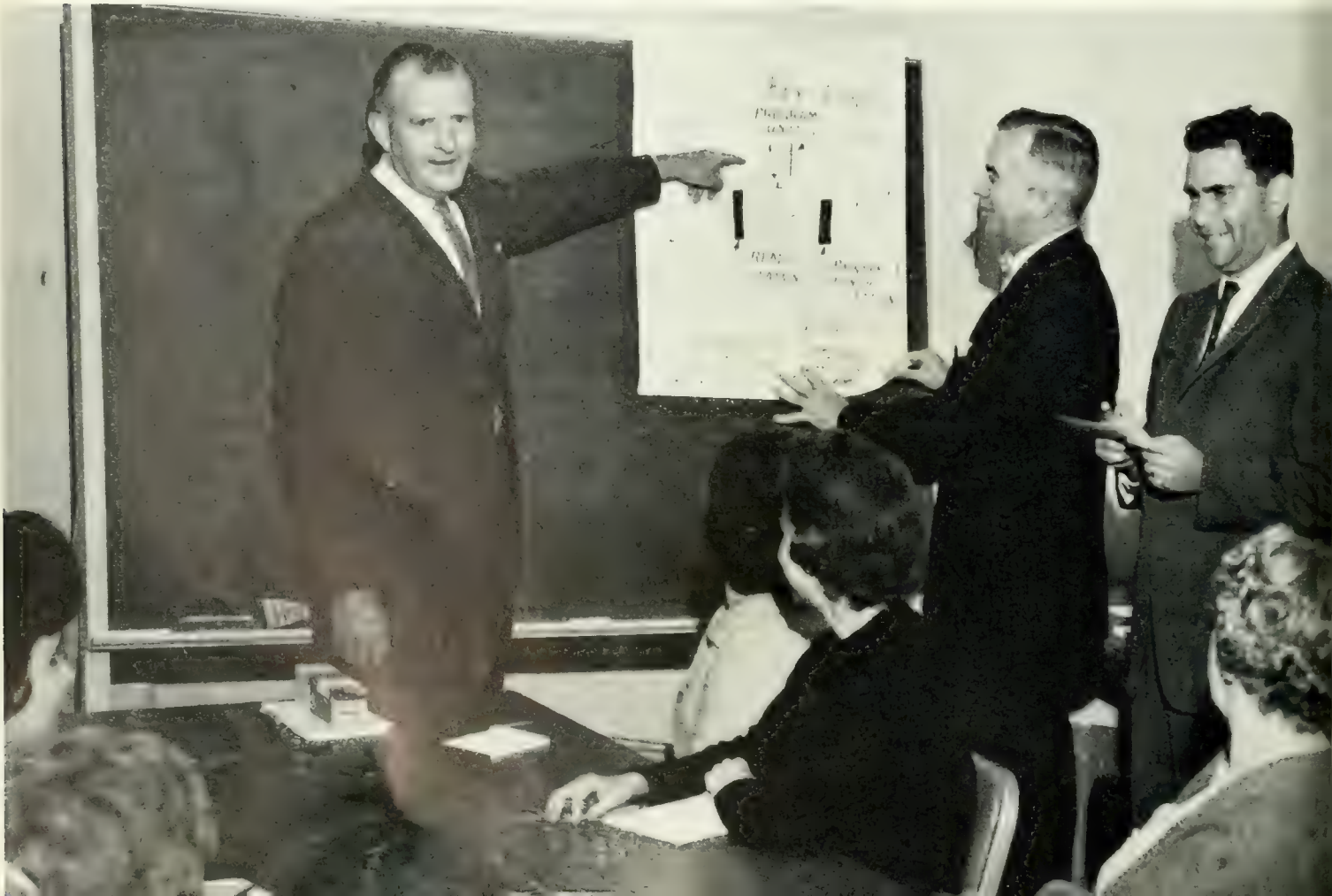
(2) Approximately $23,000,000 of federal funds anticipated in July.

Thus, the June 30, 1963, balance of $88,192,800 was the high point of the year. At the low point in February 1963, the balance fell to approximately $3,000,000, for one day. Monthly expenditures vary from $44,000,000 to $67,000,000, depending on construction weather. A major portion of the June 30, 1963, balance, $59,391,703, was invested in U.S. government securities. Also, on that same date, outstanding obligations in uncompleted contracts and day labor jobs amounted to $315,735,377.

Revenue and Expenditures

Revenues budgeted for the 1962-63 fiscal year amounted to $678,557,151, of which $257,625,425 remained to be collected on June 30, 1963. Revenue not received, which consists of $248,392,210 of federal aid and $9,233,215 of contributions from state and local agencies and other sources, will be collected as applicable work is completed or billed. Revenues budgeted for the prior fiscal year amounted to $645,832,590, the increase in the 1962-

Seminars in data processing for accounting were held throughout the State in 1963. The training team was made up of Robert G. Haness of Fiscal Management (standing right), E. J. Wintermute of the Training Section (center) and the manufacturer's representative (left). This meeting was held in Eureka.



63 fiscal year being caused primarily by a larger apportionment of federal funds.

Expenditures and obligations incurred applicable to the fiscal year ended June 30, 1963, amounted to $680,845,507, as compared to $615,605,478 for the prior fiscal year. As revenue budgeted exceeded obligations incurred by approximately $2,200,000, the unobligated budget funds increased from $116,404,664 on June 30, 1962, to $118,187,621 on June 30, 1963.

Fiscal Management Improvement

1. As a result of a drive to reduce the amount of unbilled federal reimbursement, this backlog was reduced by approximately $2,000,000 during the first six months of the fiscal year, by approximately $5,000,000 during the next four months, and by approximately $11,000,000 during the last two months, for a total reduction of approximately $18,000,000. This not only improved the cash balance of the State Highway Fund by $18,000,000 as of June 30, 1963, but also increased revenue through investment of temporary cash surplus. On an annual basis, investment of $18,000,000 would produce additional investment income of approximately $540,000.

2. Certain forms, including the Equipment Report and Motor Vehicle Log ("car tag"), were improved to make them suitable for data processing.

3. Certain tort claims will be transmitted directly to branch indicated offices in San Francisco and Los Angeles, rather than via Headquarters in Sacramento, to provide more efficient handling and improvement in collection efforts. Since timely action increases the success ratio in any bill collection effort, more tort claims will be collected under the improved procedure.

4. In January 1963, a new Reconciliation Manual was completed in time for distribution and explanation to district accounting personnel convened in annual conference in Sacramento. This manual has accelerated reconciliation of computer trial balances with those prepared manually in the districts. This has saved labor and expedited completion of accounting reports.

5. A cost analysis for rental equipment costs throughout the division was completed, with the result that the Bureau of Public Roads approved an increase in the reimbursable mileage rate for staff vehicles from .0547 cents to .0696 cents. This increased the amount of federal reimbursement by approximately $180,000 per year.

6. In co-operation with the Management Analysis Section, a study of the Materials and Research Department accounting system was completed. The result streamlined internal accounting procedures in the Laboratory, with the resultant saving of administrative effort there. It also increased federal reimbursement by .25 percent of construction cost for testing charges on interstate projects, producing an annual increase of federal reimbursement of approximately $275,000.

7. In co-operation with the Equipment Department, a standard material cost system was developed and tested successfully by Shop 10. As a result, this system is being extended throughout the Equipment Department to produce an estimated annual saving in labor cost of approximately $48,000.

Training

A significant increase in training for accounting personnel, both in districts and at Headquarters, occurred. This training not only recognized the need to give accounting personnel an awareness of technical developments in accounting equipment, particularly electronic data processing equipment, but also the need for improved communications between district and Headquarters staffs, and between accounting personnel and the engineers for whom prompt, accurate financial information is necessary in order to make good management decisions. This training included:

1. A 4-day training course, entitled "Data Processing Accounting For Management Personnel." This course was conducted both in San Francisco and Los Angeles for all district accounting officers, and key personnel from Headquarters Office. The individual most concerned with data processing in each district accounting office also attended.

2. Electronic data processing seminars were conducted in each district office. In the initial pilot program in District X, this seminar required almost two complete days, but streamlining enabled the seminar to be completed in two morning sessions in remaining district offices. This "road show" became so popular that requests for participation by various Headquarters departments led to additional sessions in Sacramento.

1964-65 Highway Budget

The California Highway Commission on October 30 budgeted $577,212,100 for state highway construction purposes, including rights-of-way and engineering, for fiscal year 1964-65.

This figure, up $22,535,016 from the 1963-64 highway budget adopted a year ago, contains $406,268,000 for major construction and improvement (including engineering), $155,444,100 for rights-of-way, plus smaller amounts for contingencies, resurfacing programs, signs and striping and minor improvements.

The $22,535,016 increase resulted from a $8,986,990 gain in federal aid for the state highway system, mostly on interstate routes, plus the expected normal increase in motor vehicle registrations which will produce additional revenue in highway user taxes.

The budget provides construction funds for 282 miles of multilane freeways, 25.2 miles of multilane expressways and 37.6 miles of two-lane expressways planned for future expansion to four-lane divided when traffic conditions warrant, in addition to numerous widening and other projects.

In submitting the budget to Governor Edmund G. Brown, Highway Transportation Agency Administrator Robert B. Bradford, Commission Chairman, said that California will continue to give priority to construction of its 2,177-mile share of the national system of interstate and defense highways. Federal law requires the system's completion by 1972.

Construction on Schedule

"Our construction progress on interstate routes is right on schedule except in San Francisco," Bradford said. "I believe we made a wise decision in concentrating our earliest interstate efforts on the more difficult and expensive portions in urban areas where traffic volumes are greatest. Interstate projects in this new budget, while still mainly on heavily traveled routes, are for the most part outside the built-up areas.

"But although a substantial portion of the new budget is earmarked for interstate routes in accordance with the federal government timetable, we have not forgotten the highway needs of motorists in any area of the State. The money is spread to remedy the most urgent highway deficiencies in line with a continuing orderly and balanced program to provide greater safety and traffic capacity for our rapidly growing population."

The budget contains $305,708,240 in federal funds, of which $256,149,540 is designated for interstate system routes.

In addition to the construction items, the Highway Commission also budgeted $78,142,000 for highway purposes other than construction, including: $45,500,000 for maintenance, $14,522,000 for administration, $7,500,000 for buildings and plants, $5,500,000 for maintenance of landscaping and functional planting, $2,800,000 for highway research and development, $1,200,000 for highway planning, $1,100,000 for honor camps, and $20,000 for legislative claims.

Nonstate Highway Items

A third budget segment totaling $140,563,101 was allocated for functions not under state highway jurisdiction.

The largest nonstate highway items are $67,714,846 for construction and rights-of-way for streets and roads on the select system of cities and counties as established by the 1963 Legislature, and $47,205,060 for improvements and maintenance work on city streets.

The other such items are $8,923,539 in federal aid for county roads on the federal aid secondary system and $4,183,306 in state funds to counties for use in matching these federal funds; $5,000,000 in state funds to help finance railroad grade separation projects on local streets and roads; $3,139,350 in state funds to pay part of the cost of extending federal aid secondary county roads into urban areas; $2,870,000 for maintenance of state-owned toll bridges; $1,400,000 in engineering funds for cities; and $127,000 for administration of the Outdoor Advertising Act.

The total estimated revenue from all state sources is $481,285,422, a gain of $90,964,380 over such revenue for the present fiscal year. This increase, however, was caused largely by Senate Bill 344, enacted during the last session of the Legislature, which added 1 cent to the gasoline tax and increased weight fees. All of the money thus obtained under Senate Bill 344, approximately $75,000,000, is earmarked for cities and counties, not for state highways.

The revenue from state sources will derive from $350,468,554 in gasoline taxes, $86,883,346 in motor vehicle fees, $27,250,000 in taxes on diesel fuel, $14,656,522 in taxes on for-hire vehicles, and $1,900,000 in interest.

Bradford pointed out that for the first time in several years the 1964-65 highway budget includes some interstate system projects which are only partly financed in the budget year, but which under current federal government procedures can be placed under contract in their entirety with the assurance that the balance will be included in the 1965-66 budget.

"This method of budgeting," he said, "allows us to go ahead with construction earlier on some of the larger projects, which will take two years to complete, without tying up the entire amount of money involved. In other words, we can start more projects earlier by spreading the financing over two budgets instead of one."

1964-65 State Highway Budget By Region, Counties

NOTE 1—The term "freeway" means a multilane divided highway with full access control, no crossings at grade, no stoplights and no left-turn movements. An "expressway" has the same access control as the freeway but does permit left turns and crossings at grade at some intersections which may or may not be signalized. Two-lane expressways are two-lane highways with some measure of access control, and are usually planned for future expansion to four lanes.

NOTE 2—Projects which overlap county lines are listed in both counties.

NOTE 3—Construction contracts financed in this new budget may be awarded beginning January 1964; right-of-way funds may not be spent until July 1, 1964, the start of the fiscal year.

NOTE 4—At the last session of the Legislature, a bill was passed which renumbers the state highway routes effective July 1, 1964. Projects in this budget are listed by both old and new route designations. If only one route number appears, the route number will not change.

NORTH COASTAL COUNTIES PROJECTS

Del Norte County

Construct two lanes of ultimate four-lane U.S. 101 Freeway between Klamath South Bank Road and the junction of existing U.S. 101 and State Highway Route 46 (new Route 169) in Klamath with an interchange for relocated Route 169 near Hoppow Creek, a distance of 1.1 miles. The project includes a 2,000-foot, two-lane bridge across the Klamath River. Estimated cost, $2,700,000.

Rights-of-way on various state highway routes—$280,000.

Humboldt County

Extend the four-lane freeway on U.S. 101 (recently completed or under construction between Englewood and Sylvandale) another 2.6 miles southerly to Dean Creek, about six miles south of Phillipsville. Estimated cost, $2,300,000.

Construct interchange at Fourth Street in Arcata, an overcrossing for Old Arcata Road-Seventh Street and new ramp connections to South G Street south of the city to convert 1.5 miles of U.S. 101 Expressway to four-lane freeway. Estimated cost, $1,160,000.

Extend U.S. 299 Expressway four miles easterly as a four-lane freeway from 0.2 mile west of Mad River to west of Chartin Road (County Road 364), and construct a two-lane road between the end of the freeway and U.S. 299 at Greenwood Road in the City of Blue Lake. Interchanges will be provided at North Bank Road (State Highway Route 85), Essex Lane Road, and Glendale Road. The project includes grading another 0.8 mile of roadway north of Blue Lake for future easterly extension of the freeway. Estimated cost, $5,600,000.

Install culverts and grade for two-lane expressway on U.S. 299 on new alignment between 1.6 and 2.2 miles east of Redwood Creek, about 18 miles east of Blue Lake. Estimated cost, $270,000.

Replace two sidehill viaduct bridges and eliminate two others by minor realignment and replace three crib retaining walls on State Sign Route 96 between 5.4 miles north of Willow Creek and 4.5 miles south of Weitchpec. Estimated cost, $270,000.

Widen and realign portions of State Sign Route 36 to ease curves between 1.3 and 10 miles east of Bridgeville. Estimated cost, $100,000.

Rights-of-way on various state highway routes—$940,000.

Lake County

Resurface State Sign Route 29 and State Highway Route 243 (new State Sign Route 29) between Kelseyville and Lower Lake, a distance of 14.8 miles. Estimated cost, $270,000.

Rights-of-way on various state highway routes—$600,000.

Mendocino County

Construct two-lane expressway on State Sign Route 1 on new alignment between Russian Gulch north of Mendocino and existing State Sign Route 1 west of Jughandle Creek, a distance of about 4.6 miles, and a two-lane expressway section on existing alignment northerly to Mitchell Creek, a distance of about 1.1 miles, for a total length of 5.7 miles. The project includes an 860-foot bridge across Casper Creek. Estimated cost, $2,230,000.

Realign U.S. 101 to eliminate a dangerous curve at Red Hill between 2.3 and 1.6 miles south of Laytonville. Estimated cost, $135,000.

Rights-of-way on various state highway routes—$605,000.

SACRAMENTO VALLEY AND NORTHERN VALLEY PROJECTS

Butte County

Construct four-lane freeway section on U.S. 99E (new U.S. 99) between Palmetto Avenue and north of Mud Creek with interchanges at Cohasset Road, East Avenue and Eaton Road, a distance of 5.4 miles, to complete freeway construction through Chico. Estimated cost, $4,100,000.

Landscape U.S. 99E (new U.S. 99) Freeway now under construction between Little Chico Creek and East Eighth Street in Chico. Estimated cost, $50,000.

Rights-of-way on various state highway routes—$120,000.

Colusa County

Rights-of-way on various state highway routes—$272,500.

El Dorado County

Extend U.S. 50 Freeway (between Sunrise Boulevard and 0.5 mile east of Folsom Junction in Sacramento County) 10 miles easterly, to 1 mile east of Bass Lake Road in El Dorado County with interchanges at Prairie City Road, relocated Scott Road, El Dorado Hills Boulevard and Bass Lake Road. Estimated cost, $6,200,000. (This project also listed in Sacramento County.)

Widen U.S. 50 from two lanes to four between 2.1 and 2.9 miles east of Phillips to provide passing lanes. Estimated cost, $110,000.

Construct two-lane State Highway Route 93 (new State Sign Route 193) on new alignment between two and four miles east of Cool. Estimated cost, $100,000.

Rights-of-way on various state highway routes—$375,000.

Glenn County

Construct four-lane Interstate 5 Freeway between one mile north of Artois and the Tehama county line with interchanges at County Roads 16, 7 and 33 and State Sign Route 32—Newville Road, a distance of 11 miles. The project involves extending State Sign Route 32 from its terminus in Orland westerly to the new freeway. Estimated cost, $6,600,000, of which $3,500,000 will be budgeted in fiscal year 1965-66.

Replace a narrow bridge on State Highway Route 45 (new State Sign Route 162) across a Sacramento River overflow channel, approximately 0.2 mile west of Afton Road, with a 32-foot-wide bridge. Estimated cost, $60,000.

Rights-of-way on various state highway routes—$325,000.

Lassen County

Widen and add a truck climbing lane for westbound traffic on State Sign Route 36 between 0.6 mile west of Eagle Lake Road and Main Street in Susanville, a distance of 3.2 miles. Estimated cost, $310,000.

Rights-of-way on various state highway routes—$90,000.

Modoc County

Surface U.S. 299 between U.S. 395 northeast of Alturas and 3.4 miles easterly and realign another 4.6 miles to County Road 58-A west of Cedarville. Estimated cost, $850,000.

Rights-of-way on various state highway routes—$53,000.

Nevada County

Construct the first unit of the four-lane Grass Valley-Nevada City Freeway (State Sign Route 20) between Brunswick Road through Nevada City and 0.7 mile easterly, a distance of 3.3 miles. Estimated cost, $4,150,000.

Widen and improve alignment of State Sign Route 49 between 0.2 mile south of Bridgeport Road and 1 mile south of North San Juan, a distance of 1.2 miles. Estimated cost, $80,000.

Rights-of-way on various state highway routes—$275,000.

Placer County

Construct the Crystal Springs Interchange on U.S. 40 (Interstate 80), approximately 0.5 mile west of Baxter. Estimated cost, $300,000.

Rights-of-way on various state highway routes—$660,000.

Plumas County

Construct two-lane expressway on new alignment on U.S. 40 Alternate (new State Sign Route 70) between 1.8 miles east of Sloat Road and 1.8 miles west of State Sign Route 89 at Blairsden, a distance of 4.8 miles. Estimated cost, $1,730,000.

Rights-of-way on various state highway routes—$131,500.

Sacramento County

Construct the superstructure of the W-X Street Bridge and the six- and eight-lane freeway approaches between 0.3 mile west of Westacre Road in Yolo County and Fifth Street in Sacramento, a distance of 2 miles. Estimated cost, $18,200,000 of which $7,200,000 will be budgeted in fiscal year 1965-66. (This project also listed in Yolo County.)

Construct the eight-lane Interstate 80 (29th-30th Street) Freeway connecting the South Sacramento and the Elvas Freeways between Fifth Avenue and north of A Street in Sacramento, and portions of the interchange with the future W-X Street Freeway, and connections to city streets. Estimated cost, $12,700,000 of which $3,950,000 will be budgeted in fiscal year 1965-66.

Construct the Capitol Mall Overcrossing for the future Interstate 5 (Second and Third Street) Freeway in Sacramento and approaches, completing mall construction between Fourth Street and the Tower Bridge. Estimated cost, $1,200,000.

Extend U.S. 50 Freeway (between Sunrise Boulevard and 0.5 mile east of Folsom Junction in Sacramento County) 10 miles easterly, to 1 mile east of Bass Lake Road in El Dorado County with interchanges at Prairie City Road, relocated Scott Road, El Dorado Hills Boulevard and Bass Lake Road. Estimated cost, $6,200,000. (This project also listed in El Dorado County.)

Reconstruct the Madison Avenue Interchange on Interstate 80 east of McClellan Air Force Base to provide for four lanes on Madison Avenue and future freeway widening. Estimated cost, $655,000.

Improve alignment on portions of State Sign Route 16 between Grant Line Road and the Amador county line. Estimated cost, $200,000.

Rights-of-way on various state highway routes—$14,235,000.

Shasta County

Extend four-lane Interstate 5 Freeway construction in progress (between 0.7 mile north of Red Bluff and 2 miles north of the Tehama county line) another 5 miles northerly to the Sacramento River through Anderson with interchanges at South Anderson, Deschutes Road, Balls Ferry Road, North Street and Riverside Avenue. Estimated cost, $4,320,000, of which $1,920,000 will be budgeted in fiscal year 1965-66.

Widen Pit River Bridge on U.S. 99 (future Interstate 5) from 44 to 56 feet. Estimated cost, $920,000.

Extend two-lane State Sign Route 44 Expressway (between Airport Road east of Enterprise and Deschutes Road in Palo Cedro) another 4 miles easterly to 0.9 mile east of Millville. Estimated cost, $880,000.

Rights-of-way on various state highway routes—$1,483,000.

Sierra County

Widen and resurface portions of State Sign Route 49 between Bassetts and Yuba Pass. Estimated cost, $70,000.

Rights-of-way on various state highway routes—$30,000.

Siskiyou County

Construct the Park Avenue frontage road including a bridge across the Sacramento River and an interchange with U.S. 99 to convert four-lane U.S. 99 Expressway to Interstate 5 Freeway between 0.2 mile south and 0.9 mile north of the Sacramento River Bridge in Dunsmuir, in Siskiyou County. Estimated cost, $1,430,000.

Rights-of-way on various state highway routes—$460,000.

Sutter County

Widen State Sign Route 20 from two lanes to four between Harter Road and U.S. 40 Alternate (new U.S. 99) west of Yuba City, a distance of 1.1 miles. Estimated cost, $290,000.

Widen U.S. 40 Alternate (new State Sign Route 113) from the Sutter Bypass Causeway northerly to Tudor Road, a distance of 2.4 miles. Estimated cost, $53,000.

Rights-of-way on various state highway routes—$235,000.

Tehama County

Extend Interstate 5 Freeway construction in progress (between 2 miles north of Tehama-Shasta county line and 0.7 mile north of Red Bluff) another 22.1 miles southerly to Corning Road near Corning with interchanges at Finnel Avenue, Gyle Road, Las Flores Avenue, South Red Bluff, U.S. 99E (new U.S. 99) and North Red Bluff. Estimated cost, $13,460,000, of which $4,850,000 will be budgeted in fiscal year 1965-66.

Replace a timber bridge across Long Gulch on State Sign Route 36 with a wider reinforced concrete bridge and reconstruct approaches, about 18 miles west of Red Bluff. Estimated cost, $80,000.

Rights-of-way on various state highway routes—$270,000.

Trinity County

Widen and surface Bramlot and Cold Creek roads, newly acquired in the state highway system for improved realignment of State Sign Route 36, between Dubakella Mountain Road and 4.5 miles west of the Shasta county line, a distance of 9.6 miles. Estimated cost, $200,000.

Rights-of-way on various state highway routes—$105,000.

Yolo County

Construct the superstructure of the W-X Street Bridge and the six- and eight-lane freeway approaches between 0.3 mile west of Westacre Road in Yolo county and Fifth Street in Sacramento, a distance of 2 miles. Estimated cost, $18,200,000 of which $7,200,000 will be budgeted in fiscal year 1965-66. (Project also listed in Sacramento County.)

Landscape U.S. 40 between Jefferson Boulevard in West Sacramento and the Tower Bridge. Estimated cost, $150,000.

Rights-of-way on various state highway routes—$1,810,000.

Yuba County

Construct two-lane expressway on State Sign Route 20 between Sampson Street in Marysville and the north city limit, a distance of 1.5 miles. Estimated cost, $330,000.

Install and modify traffic signals and construct channelization at various locations on U.S. 99E (new State Sign Route 70) and State Sign Route 20 in Marysville. Estimated cost, $195,000; State's share, $125,000; Marysville, $70,000.

Rights-of-way on various state highway routes—$132,000.

SAN FRANCISCO BAY REGION PROJECTS

Alameda County

Construct two additional lanes to convert new State Sign Route 92 from two-lane highway to four-lane freeway between the east end of the San Mateo-Hayward Bridge and Hesperian Boulevard in Hayward, with interchanges at Industrial Boulevard and Eden Landing-Clawiter Road, a distance of three miles. Estimated cost, $3,500,000.

Construct four-lane Warren Boulevard Freeway (new State Sign Route 13) between Atlas Avenue and the MacArthur Freeway (Interstate 580) near Calaveras Avenue in Oakland, with interchanges at Redwood Road and Carson Street, a distance of 1.3 miles. Estimated cost, $1,800,000.

Construct Interstate 580 Freeway between U.S. 50 east of Livermore southeasterly to the San Joaquin county line, a distance of 1.2 miles, with an interchange at U.S. 50. Estimated cost, $1,350,000. (This project continues in San Joaquin County between the Alameda county line and future State Sign Route 132, which will be extended six miles westerly from its present terminus near Vernalis, with interchanges at Patterson Pass Road, Corral Hollow Road and State Sign Route 132, a distance of 11 miles. Estimated cost, $7,350,000.

Renovate ventilating equipment, paint, improve drainage and resurface portions of the Caldecott Tunnel (State Sign Route 24). Estimated cost, $1,250,000.

Resurface Nimitz Freeway (State Sign Route 17) and interchanges between Williams Street in San Leandro and Hegenberger Road in Oakland. Estimated cost, $300,000.

Install overhead directional signs on Interstate 80 (U.S. 40) between the San Francisco-Oakland Bay Bridge distribution structure and 0.2 mile north of Powell Street in Emeryville. Estimated cost, $105,000.

Rights-of-way on various state highway routes—$11,593,000, including approximately $4,500,000 on Interstate 580, most of it in and east of Castro Valley; $4,640,000 on new State Sign Route 24 (Grove-Shafter route) in Oakland.

Contra Costa County

Construct four-lane State Sign Route 4 Freeway between 0.2 mile west of Cummings Skyway and 0.1 mile west of Howe Road in Martinez, a distance of five miles, with interchanges at Cummings Skyway, McEwen Road and Alhambra Avenue; and reconstruct portions and resurface this route between Willow Road east of Interstate 80 in Hercules and 0.2 mile west of Cummings Skyway, a distance of 4.2 miles. Estimated cost, $8,075,000.

Construct six-lane Interstate 680 Freeway between 0.7 mile north of the Alameda county line and one mile south of Danville, a distance of 5.7 miles, completing freeway construction between Dublin and Walnut Creek, with an interchange at Crow Canyon Road. Estimated cost, $7,700,000, of which $3,000,000 will be budgeted in fiscal year 1965-66.

Install traveling scaffolds for painting under the Crockett approaches to the northbound Carquinez bridges on Interstate 80, and traveling scaffolds, and air and water lines on the southbound structure. Estimated cost, $390,000. (Project repeated in Solano County listing.)

Construct an additional on and off ramp on Interstate 80 north of County Road 20 in and near Richmond. Estimated cost, $300,000.

Rights-of-way on various state highway routes—$915,000.

Marin County

Extend Grand Avenue across San Rafael Creek to the U.S. 101 Freeway frontage road; grade and pave Second Street between Grand Avenue Extended to Francisco Street; and realign the Irwin Street off ramp in San Rafael prior to future freeway widening. Estimated cost, $500,000.

Construct various types of median barrier on U.S. 101 between 0.4 mile south of Waldo Undercrossing north of Sausalito and Corte Madera Creek. Estimated cost, $231,000.

Resurface, reconstruct shoulders and install underdrains on portions of U.S. 101 between State Sign Route 37 in Novato and the Sonoma county line. Estimated cost, $180,000.

Rights-of-way on various state highway routes—$50,000.

Napa County

Widen State Sign Route 37 between 2.0 and 3.2 miles northeast of Vichy Avenue, northeast of Napa, a distance of 1.2 miles. Estimated cost, $65,000.

Rights-of-way on various state highway routes—$485,000.

San Francisco County

Landscape U.S. 101 (new State Sign Route 82) in San Francisco between Havelock Street north of Ocean Avenue and Mission Street. Estimated cost, $75,000.

Rights-of-way on various state highway routes—$2,190,000.

San Mateo County

Construct eight-lane Interstate 280 Freeway between Eastmoor Avenue in Daly City and 0.5 mile south of Arroyo Drive west of South San Francisco with interchanges at Westborough Boulevard, the future Hickey Boulevard extension at Collins Avenue and the future State Sign Route 1 Freeway. Estimated cost, $8,200,000, of which $4,200,000 will be budgeted in fiscal year 1965-66.

Construct two four-lane bridges across San Mateo Creek for the future Interstate 280 Freeway in and near Hillsborough. Estimated cost, $7,600,000, of which $5,100,000 will be budgeted in fiscal year 1965-66.

Widen State Sign Route 1 from two lanes to four as an interim project between 1 mile south of Sharp Park Road and Linda Mar Boulevard in Pacifica, a distance of 1.3 miles. Estimated cost, $200,000.

Resurface Skyline Boulevard (State Sign Route 5—new State Sign Route 35) between the State Sign Route 1 Interchange and Alemany Boulevard in Daly City. Estimated cost, $120,000.

Install freight elevators in the lift span towers of the Dumbarton Bridge on State Sign Route 84. Estimated cost, $120,000.

Construct median barrier and install overhead directional signs on the Bayshore Freeway (U.S. 101) between Redwood Creek Bridge in Redwood City in San Mateo County and Guadalupe Parkway Overcrossing in San Jose in Santa Clara County, completing median barrier construction between the San Francisco-Oakland Bay Bridge and San Jose. Estimated cost, $371,000. (This project repeated in the Santa Clara County listing.)

Rights-of-way on various state highway routes—$12,898,000, including $10,300,000 on the Interstate 280 Freeway.

Santa Clara County

Construct six-lane Interstate 280 Freeway between Mountain View-Stevens Creek Road in Los Altos and 0.2 mile north of Page Mill Road in Los Altos Hills, with interchanges at Magdalena and El Monte Avenues and ramp connections to Page Mill Road, a distance of 7.2 miles. Estimated cost, $8,000,000, of which $5,000,000 will be budgeted in fiscal year 1965-66.

Landscape the Interstate 280 Freeway between one mile east of Doyle Road and Forest Avenue in San Jose. Estimated cost, $250,000.

Construct the Capitol Expressway and Hellyer Avenue interchanges on the Bayshore Freeway (U.S. 101) to convert the section between 0.6 mile south of Tully Road and Coyote Creek in and near San Jose to full freeway standards. The project includes construction of frontage roads. Estimated cost, $1,155,000.

Construct the Oregon Avenue Interchange on the Bayshore Freeway (U.S. 101) and connections to the Oregon Avenue Expressway now under construction by Santa Clara County in Palo Alto. Estimated cost, $775,000.

Construct median barrier and install overhead directional signs on the Bayshore Freeway (U.S. 101) between Redwood Creek Bridge in Redwood City in San Mateo County and Guadalupe Parkway Overcrossing in San Jose in Santa Clara County, completing median barrier construction between the San Francisco-Oakland Bay Bridge and San Jose. Estimated cost, $371,000. (This project repeated in the San Mateo County listing.)

Widen three-lane Monterey Highway (U.S. 101, new State Sign Route 82) in San Jose to four lanes divided between Ford Road and 0.2 mile north of Curtner Avenue, a distance of five miles. Estimated cost, $1,135,000.

Reconstruct and widen State Sign Route 152 between 0.2 mile west of Bloomfield Road east of Gilroy and San Felipe Road west of the Hollister Wye, a distance of five miles. Estimated cost, $350,000.

Rights-of-way on various state highway routes—$5,405,000.

Santa Cruz County

Rights-of-way on various state highway routes—$60,000.

Solano County

Construct superstructure of four-lane, dual-structure Napa River Bridge on State Sign Route 48 (new State Sign Route 37) near Vallejo to replace an existing two-lane drawbridge, and place embankment for future bridge approaches. Estimated cost, $4,400,000.

Add two lanes to U.S. 40 expressway to provide six-lane Interstate 80 Freeway between 1 mile and 2.1 miles northeast of the Milk Farm north of Dixon and construct an interchange at Pedrick Road. Estimated cost, $810,000.

Construct channelization on State Sign Route 29 in Vallejo at the intersections of Mini Drive, Donner Pass Road and Redwood and Idaho Streets, and install traffic signals at the latter two intersections. Estimated cost,

$180,000; state's share, $165,000; city, $15,000.

Widen shoulders and resurface State Highway Route 101 (new Route 113) between State Sign Route 12 and Dozier, 8.2 miles north. Estimate cost, $180,000.

Install traveling scaffolds for painting under the northbound Carquinez Bridge structure approach on Interstate 80, and traveling scaffolds, air and water lines on the southbound structure. Estimated cost, $390,000. (Project repeated in Contra Costa County listing.)

Rights-of-way on various state highway routes—$215,000.

Sonoma County

Construct an interchange at Steele Lane and frontage roads to convert U.S. 101 between 0.1 mile south of Edwards Avenue and Russell Avenue in Santa Rosa from expressway to freeway standards. Estimated cost, $1,170,000.

Landscape and plant trees on the U.S. 101 and State Sign Route 12 interchanges in Santa Rosa and a total of 1.9 miles of State Sign Route 12 east and west of the interchange. Estimated cost, $200,000.

Rights-of-way on various state highway routes—$815,000.

CENTRAL COAST COUNTIES PROJECTS

Monterey County

Extend previously budgeted four-lane freeway project on U.S. 101 (between the San Luis Obispo-Monterey county line and 1.6 miles north of Gate 1, Camp Roberts) to 1.5 miles north of Bradley. The project includes constructing bridges across the Nacimiento and San Antonio Rivers and the East Garrison and North Bradley interchanges. Mileage—6.7. Estimated cost, $3,800,000.

Construct a bridge across the Salinas River, to replace the Hilltown Bridge, and a portion of an interchange at relocated Reservation Road for a future relocation of State Sign Route 68 as a four-lane freeway between 0.5 mile south of Reservation Road and 0.2 mile north of Foster Road, southwest of Salinas. The project includes grading and paving to relocate approximately one mile of Reservation and River Roads as a cooperative project with the county. Estimated cost, $1,450,000.

Widen and construct left-turn storage lanes for westbound traffic on State Sign Route 68 at the intersections of Laureles Grade, Corral de Tierra and San Benacio Roads, east of Monterey. Mileage—0.7. Estimated cost, $115,000.

Rights-of-way on various state highway routes—$750,000.

San Benito County

Widen State Sign Route 156 to four-lane expressway between U.S. 101 and San Juan Bautista. Mileage—2.4. Estimated cost, $760,000.

Resurface U.S. 101 between 0.9 mile north of State Sign Route 156 and the Santa Clara county line. Mileage—3.5. Estimated cost, $140,000.

Reconstruct shoulders on State Sign Route 25 (becomes State Sign Route 180) between State Sign Route 156 and the Santa Clara county line. Mileage—8.6. Estimated cost, $120,000.

Rights-of-way on various state highway routes—$105,000.

San Luis Obispo County

Construct the San Anselmo Road, North Templeton and State Sign Route 41 interchanges on U.S. 101 south of Paso Robles (continuing conversion of this highway from expressway to freeway standards). Estimated cost, $1,600,000.

Construct stopping area for southbound trucks on U.S. 101 at the summit of Cuesta Grade, about three miles south of Santa Margarita. Estimated cost, $60,000.

Reconstruct and widen State Sign Route 178 (becomes State Sign Route 58) between 0.5 mile east of Indian Creek and San Juan Creek, northeast of Santa Margarita. Mileage—17.3. Estimated cost, $210,000.

Rights-of-way on various state highway routes—$345,000.

Santa Barbara County

Construct four-lane freeway on State Sign Route 1 between Harriston and State Highway Route 2 (becomes State Route 135) and an interchange between the two routes, and a two-lane expressway between the interchange end 1.4 miles west of Orcutt; and construct a four-lane freeway on State Highway Route 2 (135) between the interchange and 0.3 mile north of Clark Avenue in Orcutt. Mileage—9.9. Estimated cost, $4,860,000.

Install traffic signals, highway lighting and channelization at the intersection of State Sign Route 1 and Central Avenue in Lompoc. Estimated cost, $110,000.

Construct new bridge and approaches across San Antonio Creek on State Highway Route 2 (becomes State Route 135), about seven miles west of Los Alamos. Estimated cost, $105,000.

Rights-of-way on various state highway routes—$970,000.

Ventura County

Convert 3.6 miles of the four-lane Ventura Expressway to six-lane freeway between Vineyard Avenue in El Rio and the completed freeway section near Telephone Road in Montalvo, with interchanges at Victoria Avenue, U.S. 101 Alternate and Sherwin Avenue, and an additional bridge across the Santa Clara River. Estimated cost, $7,500,000.

Replace the seawall protecting U.S. 101 2.9 miles north of Ventura. Estimated cost, $325,000.

Landscape the interchange area between the Ventura and State Sign Route 126 Freeways in Ventura, and functional and tree planting on the SSR 126 Freeway between the interchange and Wells Road northeast of the city. Estimated cost, $210,000.

Construct a northbound off ramp from the Ventura Freeway to Vista Del Mar Drive in Ventura and landscape. Estimated cost, $88,000.

Construct uphill passing lane on Ventura Boulevard (U.S. 399—new State Sign Route 33) between San Antonio Creek and Oakview, and widen to four lanes in Oakview to Santa Ana Way. Estimated cost, $175,000.

Rights-of-way on various state highway routes—$6,911,000.

SAN JOAQUIN VALLEY AND CENTRAL MOUNTAIN COUNTIES PROJECTS

Alpine County

Rights-of-way on various state highway routes—$15,000.

Amador County

Construct two-lane expressway on State Sign Route 104 (new State Sign Route 124) between 2.4 miles north of Ione and State Sign Route 16, a distance of 5.6 miles, including a bridge across Dry Creek about six miles north of Ione. Estimated cost, $1,800,000.

Rights-of-way on various state highway routes—$70,000.

Calaveras County

Rights-of-way on various state highway routes—$150,000.

Fresno County

Construct six-lane overhead structure, 0.6 mile in length, over Southern Pacific Railroad and U.S. 99 Business Route (Golden State Avenue) between Lorena Avenue and Fulton Street in Fresno, for future State Sign Route 41 freeway. Estimated cost, $3,220,000.

Construct bridge across San Joaquin River and approaches on State Sign Route 145, between 0.3 mile south of Barstow Avenue in Fresno County and 0.2 mile north of Avenue 5½ in Madera County, a length of 1.3 miles. Estimated cost, $372,000. (This project repeated under Madera County.)

Rights-of-way on various state highway routes—$2,732,000.

Inyo County

Construct two-lane highway on new location between 0.7 mile west of Cal-Electric Power Plant No. 3 and Otey's on Route 76 (new Route 168), a distance of 6.7 miles. Estimated cost $770,000.

Widen State Sign Route 127 for 7.3 miles from Death Valley Junction to Nevada state line. Estimated cost, $130,000.

Rights-of-way on various state highway routes—$100,000.

Kern County

Construct six-lane freeway on State Sign Route 178 from M Street to Mount Vernon Avenue in Bakersfield, with interchanges at Golden State and Beale Avenues, Alta Vista Drive, and Haley Street; and on new State Sign Route 58, widen 24th Street from Oak Street to B Street and convert to one-way street couplet on 23d and 24th Streets from B Street to M Street. Total length, 5.2 miles. Estimated cost, $7,885,000, not including co-operative drainage project with Kern County and City of Bakersfield.

Paving to complete four-lane freeway (grading and structures now under contract) on U.S. 466 (new State Sign Route 58) between 0.2 mile east of Keene and 0.8 mile west of Tehachapi Overhead, a distance of 8.3 miles. Estimated cost, $1,550,000.

Functional and tree planting for 5.9 miles on U.S. 99 (West Bakersfield Freeway) between 0.2 mile south of Planz Road and Minkler Spur. Estimated cost, $275,000.

Construct two-lane expressway on U.S. 395 between 0.5 mile south of China Lake Road and 1.5 miles north of Inyokern, a distance of 11.8 miles, with an interchange structure and railroad overhead at Brown Road. Estimated cost, $1,040,000.

Widen Route 142 (new Route 155) for 14.7 miles between 0.1 mile east of Woody and 1.1 miles west of Sequoia National Forest boundary. Estimated cost, $100,000.

Rights-of-way on various state highway routes—$3,018,000.

Kings County

Rights-of-way on various state highway routes—$605,000.

Madera County

Construct bridge across San Joaquin River and approaches on State Sign Route 145, between 0.3 mile south of Barstow Avenue in Fresno County and 0.2 mile north of Avenue 5½ in Madera County, a length of 1.3 miles. Estimated cost, $372,000. (This project repeated under Fresno County.)

Rights-of-way on various state highway routes—$231,000.

Mariposa County

Place base and surfacing on a two-lane expressway section on State Sign Route 49 (grading recently completed) between two miles east of Mariposa and State Sign Route 140 in Mariposa, a distance of 2.0 miles, including construction of a bridge across Stockton Creek. Estimated cost, $125,000.

Rights-of-way on various state highway routes—$140,000.

Merced County

Construct four-lane Interstate 5 Freeway between 0.2 miles south of State Sign Route 152 and 2.8 miles north of junction with State Sign Route 33 with interchanges at State Sign Route 152, Jensen Road-State Sign Route 33 and Whitworth-Romero Roads, a distance of 7.1 miles, and grading for future Interstate 5 Freeway between Snyder Road and 1.8 miles south of the Stanislaus county line, a distance of 1.5 miles. Estimated cost, $5,400,000.

Rights-of-way on various state highway routes—$535,000.

Mono County

Construct two-lane and four-lane expressway between 3.3 miles north of McGee Creek and 1 mile north of Casa Diablo on U.S. 395, with 0.5 mile of improved connection on Mammoth Lakes Highway (Route 112, new Route 203), a distance of 6.6 miles. Estimated cost, $565,000.

Widen U.S. 395 from two lanes to four, with improved drainage, for 0.3 mile in the town of Lee Vining. Estimated cost, $50,000.

Rights-of-way on various state highway routes—$231,500.

San Joaquin County

Construct four-lane Interstate 580 Freeway between Alameda county line and future State Sign Route 132 which will be extended six miles westerly from its present terminus near Vernalis, with interchanges at Patterson Pass Road, Corral Hollow Road and State Sign Route 132, a distance of 11 miles. Estimated cost, $7,350,000. This project connects to another on this route in Alameda County between the San Joaquin county line and U.S. 50 east of Livermore, a distance of 1.2 miles, with an interchange at U.S. 50. Estimated cost, $1,350,000.

Resurface U.S. 50 between 1 mile south of French Camp and State Sign Route 4 in Stockton, a distance of 5.1 miles. Estimated cost, $400,000.

Modify existing warning signals on U.S. 99 at the Sacramento, Tidewater and Eastern Railroad tracks near Washington Street in Stockton. Estimated cost, $60,000.

Rights-of-way on various state highway routes—$3,900,000.

Stanislaus County

Replace bridge across Tarantula Creek on State Sign Route 132 west of La Grange with a culvert and realign 0.5 miles east and west of the creek. Estimated cost, $75,000.

Rights-of-way on various state highway routes—$1,255,000.

Tulare County

Rights-of-way on various state highway routes—$240,000.

Tuolumne County

Extend the four-lane Twain Harte Grade Expressway recently completed on State Sign Route 108, 2.9 miles easterly as a two-lane expressway between Hunts and Confidence, and convert the two-lane expressway between 1.7 miles east of Long Barn and 2.1 miles easterly to four-lane expressway, extending a two-lane expressway section under construction between Lyons Dam Road and 1.7 miles east of Long Barn. Estimated cost, $2,040,000.

Widen State Sign Route 49 to ease a sharp curve about 5.3 miles west of Sonora, and widen and reconstruct 0.4 mile of this route about 3.9 miles west of Sonora. Estimated cost, $66,000.

Rights-of-way on various state highway routes—$180,000.

SAN BERNARDINO-RIVERSIDE COUNTIES PROJECTS

Riverside County

Reconstruct and add lanes to U.S. 60-70-99 to extend the eight-lane Interstate 10 Freeway (now under construction to the east city limit of Cabazon) another 6.1 miles easterly and construct interchanges at Verbenia Avenue and State Sign Route 111 at Palm Springs Junction west of Whitewater and bridges across Millard Canyon, Fornat and Stubby Canyon washes; and widen State Sign Route 111 Expressway from two lanes to four between U.S. 60-70-99 (Interstate 10) and the existing four-lane expressway at Windy Point, a distance of five miles, and construct an overhead across the Southern Pacific Railroad tracks and bridges across the Whitewater River Overflow and San Gorgonio River. Estimated cost, $6,300,000.

Extend a four-lane freeway project in progress on Interstate 10 (between 3.5 miles east of Indio and 10 miles easterly) to 4.4 miles east of Cottonwood Springs Road, with an interchange at State Sign Route 195-Cottonwood Springs Road, an access interchange near the Southern Counties Gas Company's compressor station 6.5 miles west of the Cottonwood Springs Interchange, and a safety rest area near former Cactus City, a distance of 14.1 miles. Estimated cost, $5,300,000.

Construct an interchange on U.S. 60-70-99 four miles northwest of Thousand Palms with extensions of Vista Chino Road from Palm Springs and Date Palm Drive from Cathedral City, and close remaining access openings to convert 3.4 miles between 4 miles northwest of Thousand Palms and Ramon Road from four-lane expressway to Interstate 10 Freeway. Estimated cost, $625,000.

Landscape Interstate 10 Freeway within the city limits of Beaumont. Estimated cost, $175,000.

Construct two additional lanes on U.S. 60 to convert a four-lane divided highway to six-lane freeway between Eighth Street in Riverside and U.S. 395 with interchanges at University Knolls, Watkins Drive, Fischer Road and U.S. 395. This project completes freeway construction between Sunnyslope and State Sign Route 79 near Moreno. Estimated cost, $3,350,000.

Widen the U.S. 91 Freeway from four lanes to six between Arlington Avenue and U.S. 60 in Riverside, a distance of 4.1 miles. Estimated cost, $735,000.

Widen State Sign Route 74 from two lanes to four between State Sign Route 79 and 1.5 miles east of Hemet, a distance of 2.1 miles. Estimated cost, $140,000.

Rights-of-way on various state highway routes—$2,535,000.

San Bernardino and Riverside Counties

Install guard railing at bridge approaches on U.S. 91 between State Sign Route 71 and Interstate 10; on portions of U.S. 60 between U.S. 91 and the University Undercrossing in Riverside; on portions of Interstate 10 between the Los Angeles county line and the east city limit of Banning; on portions of Interstate 15 between Interstate 10 and Cima Road, about 25 miles east of Baker; and on Interstate 40 at the Montara Overcrossing near the east city limit of Barstow. Estimated cost, $110,000.

San Bernardino County

Reconstruct and widen U.S. 91-466 between Cronese Valley and two miles east of Baker to convert the last segment between Barstow and the Nevada line from two-lane conventional highway to four-lane Interstate 15 Freeway, and construct the Rasor and Soda Roads, West and East Baker and State Sign Route 127 Interchanges and a bridge across the Mojave River. Distance—18.1 miles. Estimated cost, $6,600,000.

Construct an interchange on Interstate 15 (U.S. 91-66) at Townsend Street near Lenwood, 0.7 mile southwest of Barstow. Estimated cost, $400,000.

Convert the four-lane Barstow Expressway (U.S. 66-91) to Interstate 15 Freeway between Phelan Road and Palmdale Road in and near Victorville by constructing frontage roads and interchanges at Phelan Road and Bear Valley Cutoff. Estimated cost, $2,500,000.

Construct a four-lane divided highway bridge across the Colorado River on U.S. 66 for the future Interstate 40 Freeway. Estimated cost, $3,250,000; California's share, $1,850,000; Arizona's share, $1,350,000.

Widen the San Bernardino Freeway (Interstate 10) from four lanes to eight between Vineyard Avenue in Ontario and Valley Boulevard, 5.4 miles easterly. Estimated cost, $4,500,000, of which $2,000,000 will be budgeted in fiscal year 1965-66.

Widen State Sign Route 18 from two-lane highway to four-lane freeway between Camp Waterman and Panorama Point, south of the Crestline Interchange, a distance of 1.6 miles. Estimated cost, $1,175,000.

Resurface I Street in San Bernardino between Highland Avenue and 30th Street, and widen 30th Street between I Street and Valencia Avenue as a temporary route for State Sign Route 18, a distance of 2.5 miles. The 30th Street improvement will serve as a collector road for the future State Sign Route 30 Freeway. Estimated cost, $275,000.

Pave gutters and widen the cross streets through the median on Euclid Avenue (State Sign Route 30—new Route 83) between the San Bernardino Freeway and 19th Street in Upland, a distance of three miles. Estimated cost, $130,000; State's share, $100,000; city, $30,000.

Install traffic signals and channelization at various intersections on U.S. 66 between Sierra Avenue in Fontana and Muscott Street in San Bernardino. Estimated cost, $245,000; State's share, $175,000; balance to be paid by cities involved.

Install traffic signals, highway lighting, and channelization on Mission Boulevard (U.S. 60) at San Antonio, Vine, Euclid, and Sultana Avenues in Ontario. Estimated cost, $83,000; State's share, $60,000; Ontario, $23,000.

Rights-of-way on various state highway routes—$4,215,000.

LOS ANGELES REGION PROJECTS

Los Angeles County

Extend the eight-lane Pomona Freeway project (soon to be in progress between the East Los Angeles Interchange and Third Street in East Los Angeles) another 1.4 miles easterly to Woods Avenue, and construct an interchange with the Long Beach Freeway. Estimated cost, $9,750,000.

Construct the eight-lane Pomona Freeway between 0.1 mile west of Arroyo Drive in South San Gabriel and 0.3 mile east of Workman Mill Road near Industry, a distance of 4 miles, with interchanges at San Gabriel and Rosemead Boulevards, Tyler Avenue, Peck Road and the Interstate 605 Freeway. Estimated cost, $9,430,000.

Construct the eight-lane Interstate 605 Freeway between the Orange county line and the future State Sign Route 91 Freeway in Dairy Valley, a distance of 5.3 miles, with interchanges at Spring Street, Carson Avenue, Del Amo Boulevard, and South Street, and a portion of the interchange with SSR 91. Estimated cost, $14,050,000.

Extend the four-lane Antelope Valley Freeway project (now in progress between Red Rover Mine Road and Angeles Forest Highway) another 6.2 miles northeasterly to Avenue P8, with interchanges at Avenue S and Palmdale Boulevard (State Sign Route 138); and widen Palmdale Boulevard from two to four lanes divided between the freeway and Sixth Street East in Palmdale. The project includes constructing a temporary connection on Avenue P8 from the northern end of the freeway construction to Sierra Highway. Estimated cost, $5,100,000.

Construct an embankment for the future Hollywood Freeway on portions between Laurel Canyon Boulevard and the Golden State Freeway; extend the eight-lane Hollywood Freeway between Magnolia Avenue and Victory Boulevard in North Hollywood, a distance of 2.5 miles, with interchanges at Magnolia Avenue, Burbank Boulevard, Laurel Canyon Boulevard-Oxnard Street and Victory Boulevard. Estimated cost, $8,100,000.

Add one northbound lane to the six-lane Hollywood Freeway between the Franklin Avenue onramp and Pilgrimage Overcrossing in Los Angeles as first stage of widening six-lane sections to eight lanes between Sunset Boulevard and Pilgrimage Overcrossing. Estimated cost, $800,000.

Relocate ramps to and from Hollywood Freeway and Vineland Avenue in Los Angeles to connect the freeway with Ventura Boulevard and landscape. Estimated cost, $176,000.

Revise signing on the Hollywood Freeway between the four-level interchange and Sunset Boulevard in Los Angeles. Estimated cost, $140,000.

Construct portions of an interchange between the San Diego Freeway (Interstate 405) and the future State Sign Routes 1 and 90 Freeways in Los Angeles and Culver City. Estimated cost, $3,500,000.

Landscape the San Diego Freeway (Interstate 405) between El Segundo Boulevard near Hawthorne and La Tijera Boulevard in Los Angeles, and between Moraga Drive and 0.2 mile north of Chalon Road in Los Angeles. Estimated cost, $550,000.

Install irrigation system and plant screen and trees as first stage of landscaping the San Diego Freeway (Interstate 405) between the Ventura and Golden State Freeways. Estimated cost, $310,000.

Install irrigation system and plant screen and trees as first stage of landscaping the Golden State Freeway (Interstate 5) between Roscoe Boulevard and San Fernando Road. Estimated cost, $325,000.

Revise channelization on U.S. 99 at the northern and southern city limits of San Fernando to convert San Fernando Road and Truman Street from one-way to two-way operation prior to their relinquishment to the city, soon to be superseded as state highways by completion of the Golden State Freeway (Interstate 5). Estimated cost, $200,000.

Add eastbound lane to the six-lane San Bernardino Freeway between 0.4 mile west and 0.7 mile east of Vincent Avenue in West Covina and reconstruct the southern half of the Vincent Avenue Interchange. Estimated cost, $660,000.

Extend acceleration - deceleration lanes on the Harbor Freeway at three locations near the Santa Monica Freeway Interchange. Estimated cost, $252,000.

Construct a westbound offramp and eastbound onramp to the Ventura Freeway at De Soto Street in Woodland Hills. Estimated cost, $100,000.

Reconstruct four-lane divided Venice Boulevard and add two lanes in the median between Lincoln Avenue and Sepulveda Boulevard in Los Angeles and Culver City as future State Route 187. Estimated cost, $2,400,000; State's share $1,200,000. Balance to be shared by Los Angeles and the county.

Construct an interchange between Sepulveda Boulevard (U.S. 101 Alternate-new State Sign Route 1) and Century Boulevard in Los Angeles. Estimated cost, $1,700,000; State's share $850,000; balance, city.

Extend the widening of Devonshire Street (State Sign Route 118) from two to four lanes, recently completed between Sepulveda Boulevard and Zelzah Avenue, another 3.7 miles westerly to De Soto Street in Chatsworth. Estimated cost, $1,000,000.

Resurface and improve shoulders on Pacific Coast Highway (U.S. 101 Alternate-new State Sign Route 1) between Western Avenue in Los Angeles and Crenshaw Boulevard in Torrance, a distance of 1.6 miles. Estimated cost, $226,000.

Modify traffic signals and highway lighting and install channelization at various intersections on Pacific Coast Highway (U.S. 101 Alternate-new SSR 1) between Palos Verdes Boulevard in Torrance and Gould Lane in Hermosa Beach. Estimated cost, $361,000; State's share, $172,000; balance to be shared by cities involved.

Modify traffic signals and install channelization at 22 intersections on Pacific Coast Highway (U.S. 101 Alternate-new SSR 1) between Anaheim Street and Santa Fe Avenue in Long Beach and Signal Hill. Estimated cost, $202,000; State's share, $125,000; balance to be shared by cities involved.

Widen Manchester Boulevard (State Sign Route 42) to provide left-turn storage lanes between Ash and Prairie Avenues in Inglewood. Estimated cost, $325,000; State's share, $295,000; balance to be paid by Inglewood.

Modify traffic signals and install channelization at 31 intersections on Manchester Boulevard (SSR 42) between Lincoln and Central Avenues in Los Angeles and Inglewood. Estimated cost, $395,000; State's share, $212,000; balance to be paid by the cities involved.

Modify traffic signals and highway lighting at 21 intersections on Firestone Boulevard (SSR 42) between Central and Garfield Avenues in South Gate. Estimated cost, $170,000; State's share, $90,000; balance to be paid by South Gate and the county.

Construct the Jackson Street Overcrossing of the future State Sign Route 134 Freeway in Glendale, and a frontage road between Brand Boulevard and Kenwood Street. Estimated cost, $250,000

Widen Angeles Crest Highway (SSR 2) from two to four lanes between Foothill Boulevard (Interstate 210) northerly to La Canada Arch Bridge, a distance of 1.8 miles. Estimated cost, $250,000.

Reconstruct Verdugo Boulevard (State Sign Route 2) between Montrose Avenue and Foothill Boulevard (SSR 2) in and near Glendale, a distance of 1.2 miles. Estimated cost, $210,000.

Widen Alosta Avenue (U.S. 66) from two to four lanes between Ben Lomond and Loraine Avenues in Glendora, a distance of two miles. Estimated cost, $250,000.

Rights-of-way on various state highway routes—$56,855,000, including approximately $13,600,000 on Interstate 210 (mostly in the Pasadena-Glendora area), $9,500,000 on the Glendale Freeway, and $8,100,000 on the SSR 134 Freeway.

Orange County

Connect a six-lane construction project in progress on the Garden Grove Freeway between the San Diego Freeway and 0.5 mile east of Bolsa Chica Road with a second project underway between 0.2 mile southeast of Garden Grove Boulevard near Knott Avenue and Newland Street in Garden Grove. The new 1.7-mile project includes construction of an interchange at relocated Knott Avenue-Garden Grove Boulevard-Golden West Street. Estimated cost, $2,500,000.

Extend the six-lane Garden Grove Freeway (now under construction) another five miles easterly between Newland Street and 0.1 mile northeast of Garden Grove Boulevard near Haster Street in Garden Grove. The linking section between Haster Street and the completed section to the Santa Ana Freeway is financed in the 1963-64 construction budget. The project includes interchanges at Cannery, Brookhurst and Verano Streets, Trask Avenue-Harbor Boulevard, and part of the Haster Street-Garden Grove Boulevard-Berrydale Street interchange. Estimated cost, $10,700,000.

Extend the four-lane Newport Freeway (now under construction) another 3.9 miles southeasterly between Warner Avenue at the east city limit of Santa Ana and Palisades Road-Bristol Street at the east city limit of Costa Mesa, with interchanges at Talbert Avenue, MacArthur Boulevard and Baker Street-Paularino Avenue, and structures for an interchange with the future San Diego Freeway. Estimated cost, $6,300,000.

Construct embankment for future extension of the San Diego Freeway (Interstate 405) on portions between Newland Street in Westminster and Harbor Boulevard in Costa Mesa; and extend the eight-lane construction soon to be in progress for 3.1 miles southeasterly between Beach Boulevard (State Sign Route 39) and Brookhurst Avenue in Fountain Valley with interchanges at Cannery Street-Warner Avenue and Brookhurst Avenue. Estimated cost, $8,700,000, of which $4,000,000 will be budgeted in 1965-66.

Widen the Riverside Freeway from four to six lanes between 0.1 mile west of Lemon Avenue in Fullerton and the Newport Freeway in Anaheim, a distance of 5.8 miles. Estimated cost, $5,100,000.

Widen the Interstate 5 Freeway (along portions of the San Diego and Santa Ana Freeways) from four to six lanes between 0.3 mile south of Ortega Highway (State Sign Route 74) in San Juan Capistrano and the Laguna Freeway south of Irvine, a distance of 13.8 miles. Estimated cost, $2,300,000.

Landscape Interstate 5 Freeway between 0.2 mile southeast of Camino De Estrella in San Clemente and 0.1 mile northwest of Via California north of the city. Estimated cost, $175,000.

Widen State College Boulevard (new State Route 250) from two to four lanes between the Santa Ana and Riverside Freeways, a distance of 4.5 miles. Estimated cost, $700,000.

Widen existing four-lane Pacific Coast Highway (U.S. 101 Alternate-new State Sign Route 1) to four lanes divided between the south city limit and Mountain Road in Laguna Beach, and between Astor Street-Cliff Drive in Laguna Beach and the south city limit of Newport Beach. Estimated cost, $635,000.

Install traffic signals, highway lighting and channelization at the intersection of MacArthur Boulevard (new State Route 73) and Palisades Road-San Joaquin Road. Estimated cost, $67,000; State's share, $56,000; balance to be shared by the county and Newport Beach.

Rights-of-way on various state highway routes—$9,468,000, including approximately $4,000,000 on Interstate 405 (San Diego Freeway).

SAN DIEGO-IMPERIAL COUNTIES PROJECTS

Imperial County

Construct four-lane U.S. 99-State Sign Route 111 Expressway between State Sign Route 98 in Calexico and County Road 16, 0.5 mile south of the future Interstate 8 Freeway; and widen and resurface State Sign Route 111 between County Road 16 and U.S. 80 east of El Centro. Estimated cost, $2,350,000.

Widen and resurface State Sign Route 98 between 0.1 mile west of Eighth Street Extension and 0.1 mile west of State Sign Route 111 in and near Calixico, a distance of 3.5 miles. Estimated cost, $118,000.

Rights-of-way on various state highway routes—$986,000.

San Diego County

Extend the eight-lane San Diego Freeway (Interstate 5) in San Diego 2.4 miles northerly to Rosecrans Street, with interchanges at Washington and Trias Streets, a viaduct crossing of the AT&SF railroad tracks, U.S. 101 and Rosecrans Street, and temporary connections to U.S. 101. Estimated cost, $8,250,000, of which $5,250,000 will be budgeted in fiscal year 1965-66.

Construct the eight-lane San Diego Freeway (Interstate 5) in Rose Canyon on improved alignment between 0.1-mile and 4.3 miles north of Balboa Avenue in San Diego, and construct a connection with existing U.S. 101 and an interchange with Ardath Road-future Route 52 Freeway. Estimated cost, $7,750,000.

Construct six-lane section for future San Diego Freeway (Interstate 5) between Miramar Road at the north limit of Camp Mathews and 0.5 mile south of Carmel Valley Road in San Diego with interchanges at Genesee Avenue, Sorrento Valley Road, and the future Interstate 805 Freeway in Sorrento Valley, a distance of 3.4 miles. Estimated cost, $6,230,000.

Construct eight-lane section for future San Diego Freeway (Interstate 5) between 0.1 mile south of San Marcos Road near Encinitas and 4.4 miles south of State Sign Route 78 Expressway with interchanges at San Marcos Road, Woodley Road and La Costa Avenue and a bridge across Batiquitos Lagoon, a distance of 5.4 miles. Estimated cost, $4,800,000.

Landscape the San Diego Freeway (Interstate 5) between "A" Street and Park Boulevard in San Diego and the interchange with State Sign Route 94. Estimated cost, $150,000.

Construct four-lane Interstate 8 Freeway (U.S. 80) between 0.3 mile west of Harritt Road and 4.3 miles west of Alpine, with an interchange at Harritt Road, a distance of 3.5 miles. Estimated cost, $3,250,000.

Widen U.S. 395 from two lanes to four to provide a freeway section between 0.6 mile south and 2.6 miles north of Miramar Road in San Diego with interchanges at Miramar Road and Mira Mesa Boulevard, a distance of 3.2 miles. Estimated cost, $1,800,000.

Widen U.S. 395 from two lanes to four to provide an expressway section between 0.3 mile and 2.6 miles north of State Sign Route 78 Freeway as an interim improvement pending U.S. 395 Freeway construction in and near Escondido, a distance of 2.3 miles. Estimated cost, $500,000.

Widen the Clairemont Mesa Boulevard Overcrossing from two lanes to four and revise the interchange connections to U.S. 395 in San Diego. Estimated cost, $390,000; State's share, $340,000; city, $50,000.

Construct four-lane State Sign Route 67 Freeway between 1.5 miles and 3.2 miles north of Interstate 8 near Santee. The project includes additional grading and frontage road construction northerly to Riverford Road and construction of on and off ramps at Prospect and Woodside Avenues. Estimated cost, $1,250,000.

Realign 0.8 mile of State Sign Route 94 to ease curves within the Campo Indian Reservation, about 8.2 miles east of Campo. Estimated cost, $115,000.

Construct additional on and off ramps on the State Sign Route 94 Freeway west of 56th Street in San Diego to provide service to and from the west. Estimated cost, $100,000.

Construct a frontage road to connect College Boulevard in Oceanside to the State Sign Route 78 Expressway to serve the Oceanside-Carlsbad Junior College now under construction. Estimated cost, $165,000.

Resurface portions of U.S. 101 in National City and San Diego; and in San Diego on U.S. 395, State Sign Route 94, and Wabash Boulevard prior to relinquishment to the cities. These sections have been superseded as state highways by freeway construction. Estimated cost, $200,000.

Rights-of-way on various state highway routes—$11,047,000.

STATE OF CALIFORNIA

EDMUND G. BROWN, *Governor*

HIGHWAY TRANSPORTATION AGENCY

ROBERT B. BRADFORD . . . Administrator

DEPARTMENT OF PUBLIC WORKS . . . JOHN ERRECA, Director

FRANK A. CHAMBERS . . . . Chief Deputy Director

RUSSELL J. COONEY . . Deputy Director (Management)
HARRY D. FREEMAN . . Deputy Director (Planning)

T. F. BAGSHAW . . . . . Assistant Director
C. RAY VARLEY . . . . . Assistant Director

JUSTIN DuCRAY . Departmental Management Analyst
S. ALAN WHITE . . Departmental Personnel Officer

DIVISION OF HIGHWAYS

J. C. WOMACK . . . State Highway Engineer, Chief of Division

J. P. MURPHY . . . Deputy State Highway Engineer
J. A. LEGARRA . . Deputy State Highway Engineer
GEO. LANGSNER . . Deputy State Highway Engineer
LYMAN R. GILLIS . Assistant State Highway Engineer
J. E. McMAHON . . Assistant State Highway Engineer
FRANK E. BAXTER . Assistant State Highway Engineer
GEORGE A. HILL . Assistant State Highway Engineer
J. C. BURRILL . . . . . Comptroller
NEAL A. ANDERSEN . . . . Equipment Engineer
JOHN L. BEATON . . Materials and Research Engineer
C. G. BEER . . . . . Urban Planner
J. F. JORGENSEN . . . . . Construction Engineer
SCOTT H. LATHROP . Personnel and Public Information
C. T. LEDDEN . . City and County Projects Engineer
H. C. McCARTY . . . . . Office Engineer
DANA G. PENGILLY . . . . . Planning Engineer
E. J. L. PETERSON . . Program and Budget Engineer
R. V. POTTER . . . . Systems Research Engineer
E. L. TINNEY . . . . . Maintenance Engineer
W. L. WARREN . . . . . Engineer of Design
J. E. WILSON . . . . . Traffic Engineer
A. L. ELLIOTT . . . . Bridge Engineer—Planning
R. J. IVY . . . Bridge Engineer—Special Projects
I. O. JAHLSTROM . . . Bridge Engineer—Operations
DALE DOWNING . . Bridge Engineer—Southern Area

Right of Way

RUDOLF HESS . . . . . Chief Right of Way Agent
DEXTER D. MacBRIDE . . . . . Assistant Chief
RAY E. O'BIER . . . . . Assistant Chief
R. S. J. PIANEZZI . . . . . Assistant Chief

District I, Eureka

SAM HELWER . . . . . District Engineer

District II, Redding

H. S. MILES . . . . . District Engineer

District III, Marysville

ALAN S. HART . . Assistant State Highway Engineer

District IV, San Francisco

J. P. SINCLAIR . . Assistant State Highway Engineer
R. A. HAYLER . . . . . District Engineer
HAIG AYANIAN . . . . . District Engineer
C. F. GREENE . . . . . District Engineer

District V, San Luis Obispo

R. J. DATEL . . . . . District Engineer

District VI, Fresno

W. L. WELCH . . . . . District Engineer

District VII, Los Angeles

E. T. TELFORD . . . Metropolitan District Engineer
A. L. HIMELHOCH . . . . . District Engineer
A. C. BIRNIE . . . . . District Engineer
A. W. HOY . . . . . District Engineer
R. E. DEFFEBACH . . . . . District Engineer

CALIFORNIA HIGHWAY COMMISSION

ROBERT B. BRADFORD . Chairman and Administrator, Highway Transportation Agency
JAMES A. GUTHRIE . . Vice Chairman San Bernardino
ARTHUR T. LUDDY . . . Sacramento
ROGER S. WOOLLEY . . . San Diego
ABRAHAM KOFMAN . . . . Alameda
FRANKLIN S. PAYNE . . Los Angeles
WILLIAM S. WHITEHURST . . . Fresno

JOHN ERRECA . Administrative Officer and Director of Public Works
JACK COOPER, Secretary . . . Sacramento

District VIII, San Bernardino

C. V. KANE . . . . . District Engineer

District IX, Bishop

C. A. SHERVINGTON . . . . . District Engineer

District X, Stockton

JOHN G. MEYER . . . . . District Engineer

District XI, San Diego

JACOB DEKEMA . . Assistant State Highway Engineer

DIVISION OF CONTRACTS AND RIGHTS OF WAY

HARRY S. FENTON . . . . . Chief Counsel

EMERSON RHYNER . . . Deputy Chief (Sacramento)
HOLLOWAY JONES . . . Deputy Chief (San Francisco)
GEORGE C. HADLEY . . . Deputy Chief (Los Angeles)

DIVISION OF BAY TOLL CROSSINGS

E. R. FOLEY . . . . . Chief Engineer

BEN BALALA . . . . . Planning and Construction
CHARLES L. SWEET . . . . . Operations

DIVISION OF AERONAUTICS

CLYDE P. BARNETT . . . . . Director, Chief of Division

99668 11 63 60 500

printed in the [illegible] STATE PRINTER

SEATTLE PUBLIC LIBRARY
4TH & MADISON
SEATTLE 4, WASHINGTON

R56

California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

RETURN REQUESTED

BULK RATE
U. S. POSTAGE
PAID
Sacramento, Cal
Permit No. 152




SEATTLE PUBLIC LIBRARY

SEATTLE PUBLIC LIBRARY